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American Machinist

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How Much of *Your* Equipment Is More Than Ten Years Old?

Self-analysis of the plant referred to in this article shows 38 per cent of its equipment more than ten years old. How is yours?

OBSOLESCENCE of equipment, because of its great influence toward the high cost of production, must not be overlooked by management. Only a careful analysis can show to what extent obsolescence exists in the specific plant. It is easily conceivable that a manager might consider his plant to be thoroughly up-to-date when it is not. Time passes rapidly, and a machine becomes ten, fifteen, or twenty years old almost before the owner realizes that it is out-of-date.

Any user of machine shop equipment can secure a graphic analysis of the condition of his equipment by constructing charts similar to those illustrated on the following pages

To illustrate this point: An analysis to show the average years of service of the machine tool equipment of a medium-sized plant demonstrated that on the average the machines had given 13.5 years of service. In the pattern shops the machine tools ordinarily operating intermittently had given an average service of 21.8 years. The oldest machine had been installed in 1891.

The average of years of service was 12.5 for the machine tools in the machine shop ordinarily operating intermittently. The oldest machine was installed in 1891.

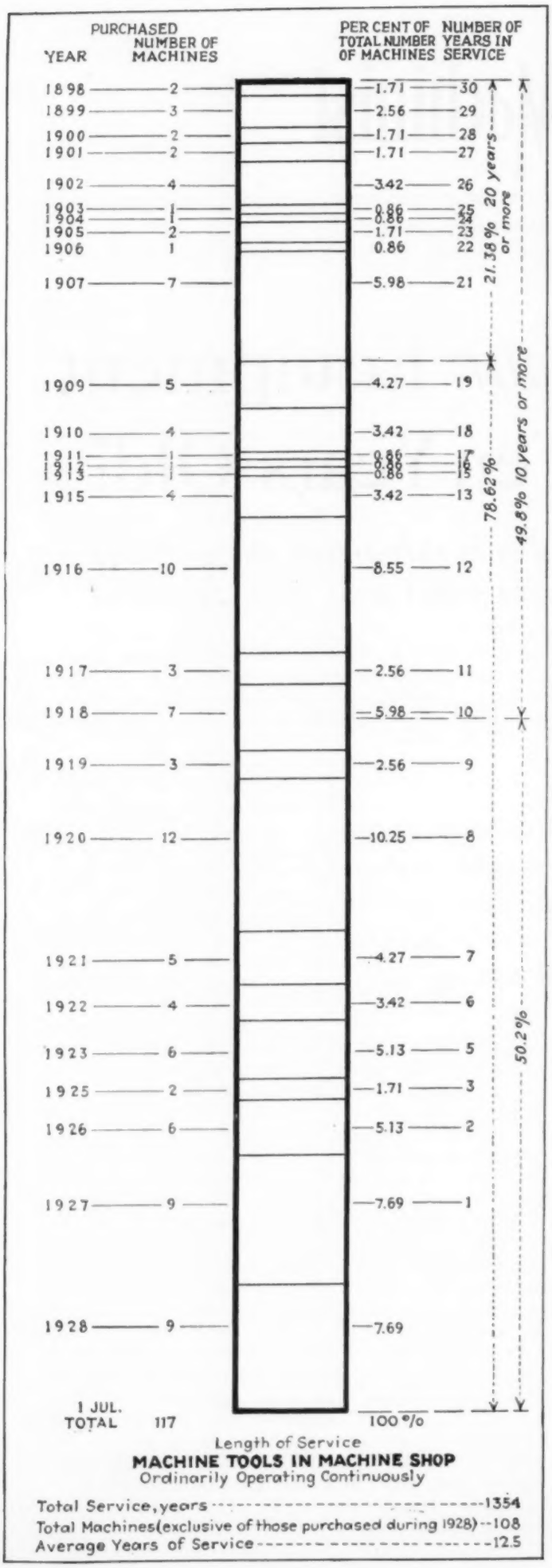
It seems peculiar enough that the average of years of service in the toolroom was 9.2. According to usual practice the machines in the toolroom are not roughly treated and last for many years. Evidently the policy of this company is to keep its toolroom equipment strictly up-to-date and to be less careful with its manufacturing equipment. However, in the toolroom the oldest machine was installed in 1899.

The details of the machines as to years of service and dates of installation for the several departments and for the plant as a whole are shown in the accompanying charts. It is significant that the machines in the blacksmith shop have given an average service of 21.5 years. This probably means that the development and improvement of smithing equipment has been very slow. In other words, what was good enough twenty years ago is good enough today for the class of work involved. Undoubtedly a great deal of the work formerly done in the blacksmith shop has been transferred to other departments.

It is suggested that manufacturers of products made from metal, that is, manufacturers using metal working equipment, should analyze their equipment as has been done in the examples given. Probably some of the facts brought to light will be very surprising. It is likely that many machines more than ten years old will be found and will be discarded. The user will put in modern equipment that will more than double the output from his ancient machines.

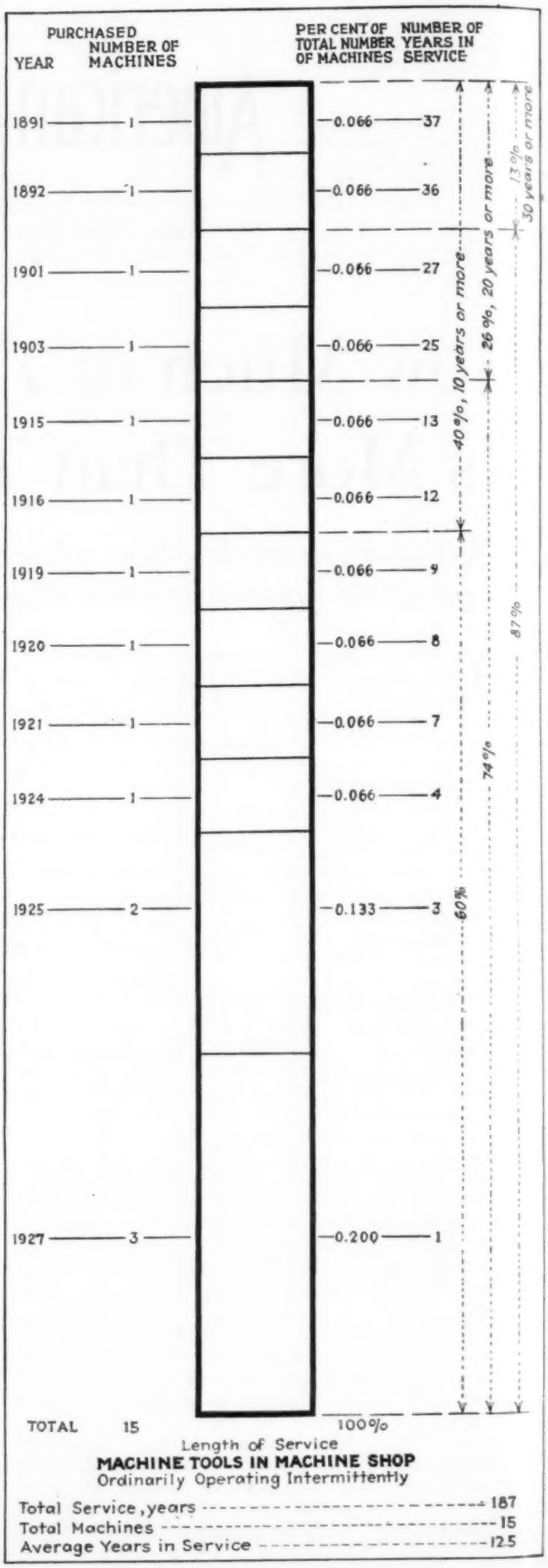
According to the statistics gained by a survey conducted by the *American Machinist* and published in Vol. 66, No. 19, 44 per cent of all metal working equipment at the beginning of the year 1926 was at least ten years old. Analysis of the accompanying charts shows that of the total of 166 machines, 64 were installed prior to 1916. The percentage of equipment at least ten years old at the beginning of 1926 was, therefore, approximately 38.55. This figure is comparable to the 44 per cent given above. The plant is well above the average, yet the charts show a surprising number of machines that have been in service twenty years or longer.

In order to lay out one of the charts as for example in Fig. 1, it is necessary to have the records in individual equipment purchases as to time of purchase. This information is then plotted cumulatively on the left-hand side beginning with the oldest machine. When this has been done percentages represented by each year's purchase together with years of service are plotted on the right-hand side. The machines on the right will add up to the total in service.



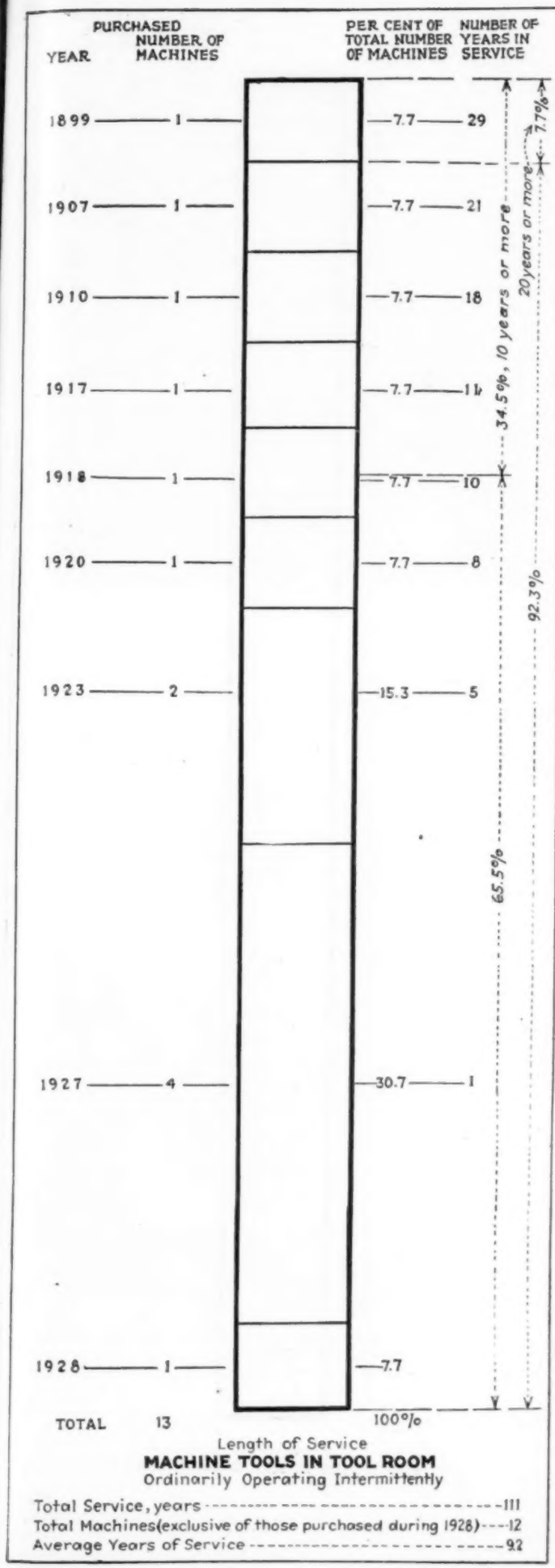
MACHINE TOOLS IN MACHINE SHOP
Ordinarily Operating Continuously

Total Service, years	1354
Total Machines (exclusive of those purchased during 1928)	108
Average Years of Service	12.5



MACHINE TOOLS IN MACHINE SHOP
Ordinarily Operating Intermittently

Total Service, years	187
Total Machines	15
Average Years in Service	12.5

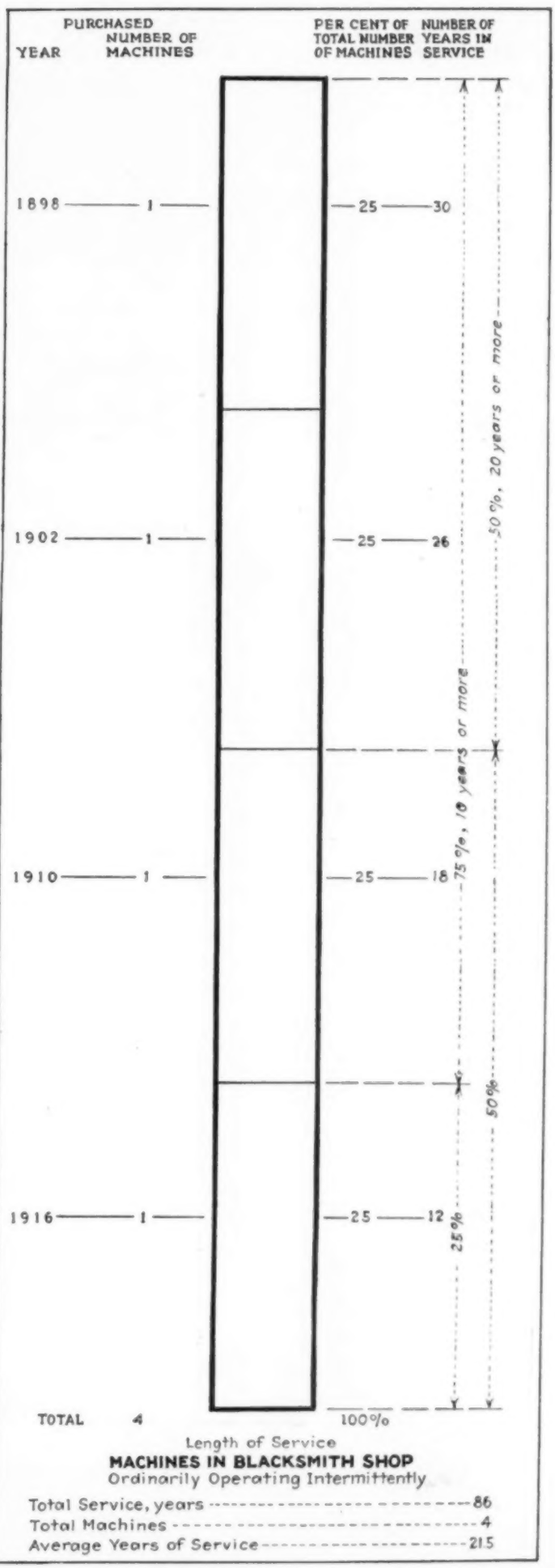

PURCHASED NUMBER OF MACHINES
YEAR
PER CENT OF TOTAL NUMBER OF MACHINES
NUMBER OF YEARS IN SERVICE
1899 — 1 — 7.7 — 29
1907 — 1 — 7.7 — 21
1910 — 1 — 7.7 — 18
1917 — 1 — 7.7 — 11
1918 — 1 — 7.7 — 10
1920 — 1 — 7.7 — 8
1923 — 2 — 15.3 — 5
1927 — 4 — 30.7 — 1
1928 — 1 — 7.7
TOTAL 13 100%
7.7%
20 years or more
34.5%, 10 years or more
92.3%
65.5%

Length of Service

MACHINE TOOLS IN TOOL ROOM

Ordinarily Operating Intermittently

Total Service, years	111
Total Machines (exclusive of those purchased during 1928)	12
Average Years of Service	9.2

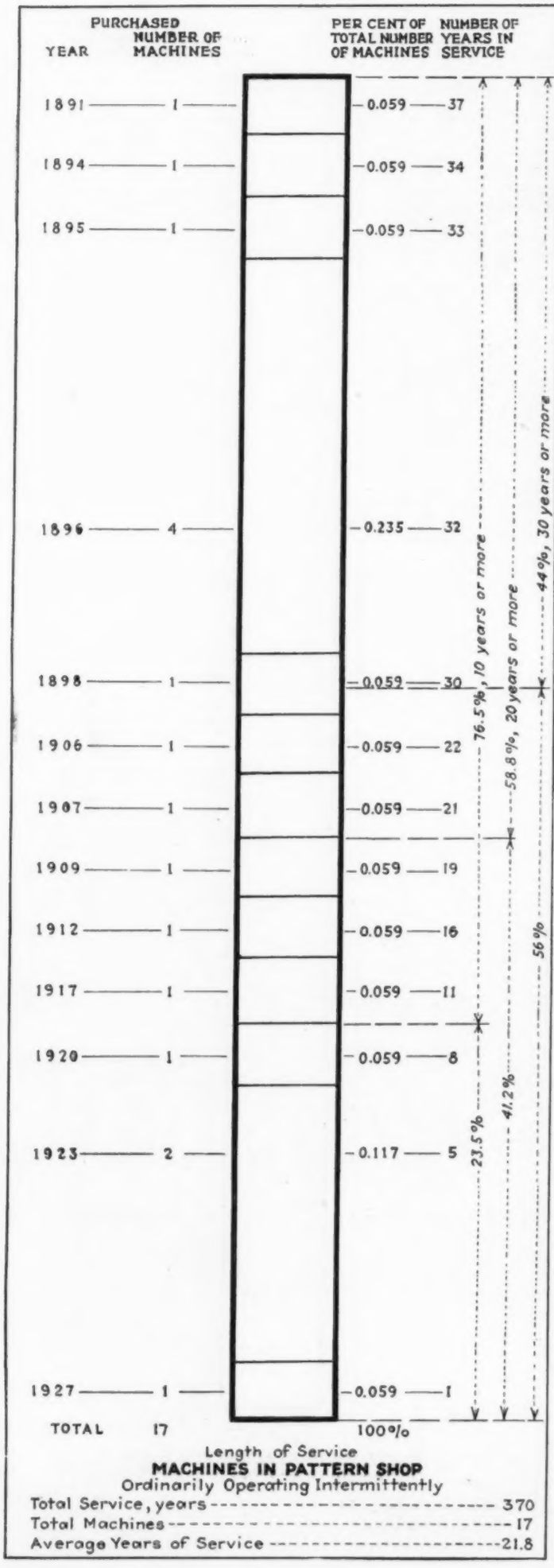

PURCHASED NUMBER OF MACHINES
YEAR
PER CENT OF TOTAL NUMBER OF MACHINES
NUMBER OF YEARS IN SERVICE
1898 — 1 — 25 — 30
1902 — 1 — 25 — 26
1910 — 1 — 25 — 18
1916 — 1 — 25 — 12
TOTAL 4 100%
50%, 20 years or more
75%, 10 years or more
50%
25%

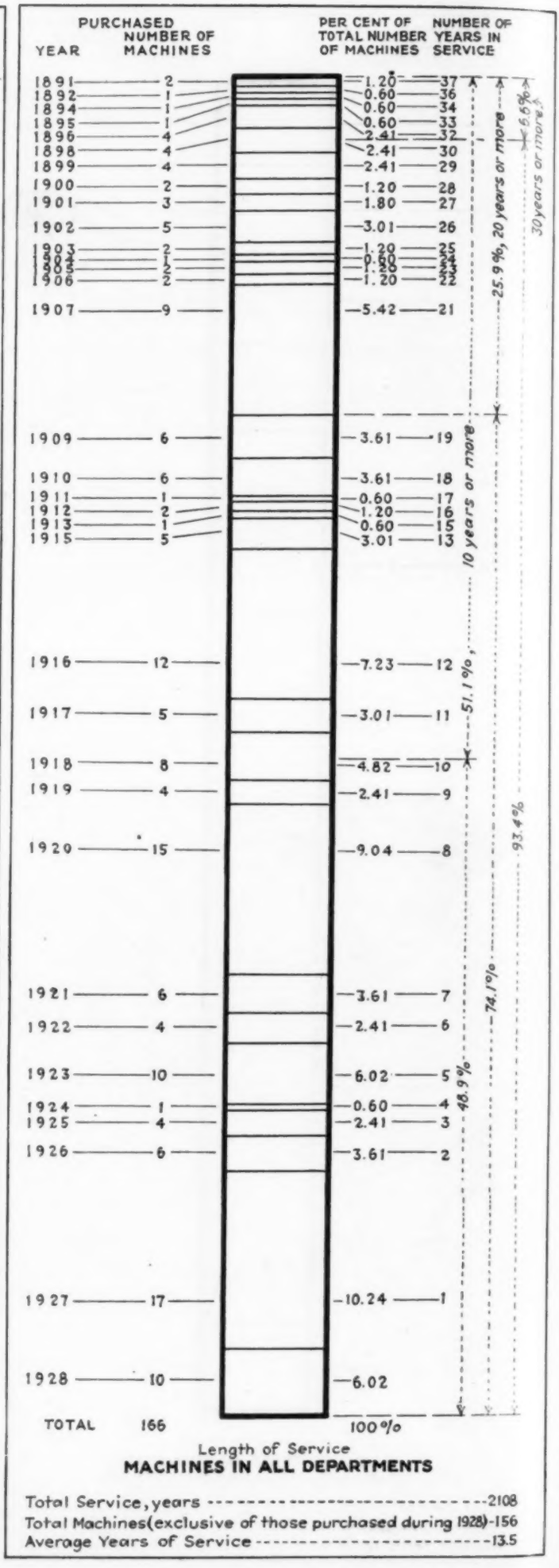
Length of Service

MACHINES IN BLACKSMITH SHOP

Ordinarily Operating Intermittently

Total Service, years	86
Total Machines	4
Average Years of Service	21.5

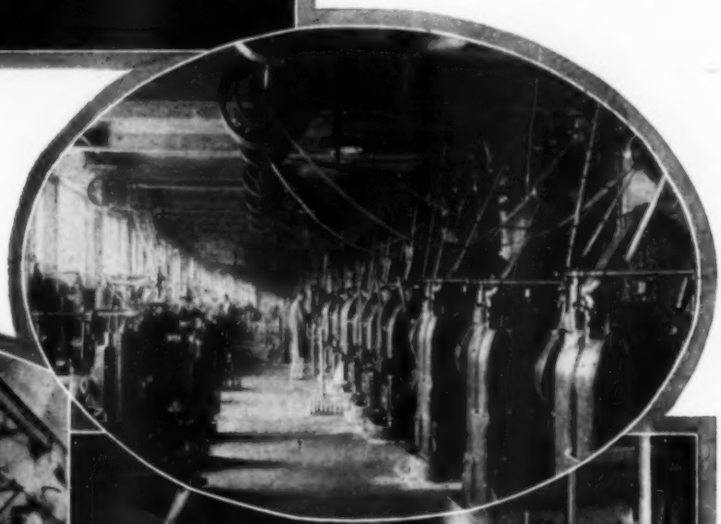

PURCHASED NUMBER OF MACHINES
YEAR
PER CENT OF TOTAL NUMBER OF MACHINES
NUMBER OF YEARS IN SERVICE
1891 — 1 — 0.059 — 37
1894 — 1 — 0.059 — 34
1895 — 1 — 0.059 — 33
1896 — 4 — 0.235 — 32
1898 — 1 — 0.059 — 30
1906 — 1 — 0.059 — 22
1907 — 1 — 0.059 — 21
1909 — 1 — 0.059 — 19
1912 — 1 — 0.059 — 16
1917 — 1 — 0.059 — 11
1920 — 1 — 0.059 — 8
1923 — 2 — 0.117 — 5
1927 — 1 — 0.059 — 1
TOTAL 17 100%
76.5%, 10 years or more
58.8%, 20 years or more
44%, 30 years or more
23.5%
41.2%
56%
Length of Service
MACHINES IN PATTERN SHOP
Ordinarily Operating Intermittently
Total Service, years ---------- 370
Total Machines ---------- 17
Average Years of Service ---------- 21.8


PURCHASED NUMBER OF MACHINES
YEAR
PER CENT OF TOTAL NUMBER OF MACHINES
NUMBER OF YEARS IN SERVICE
1891 — 2 — 1.20 — 37
1892 — 1 — 0.60 — 36
1894 — 1 — 0.60 — 34
1895 — 1 — 0.60 — 33
1896 — 4 — 2.41 — 32
1898 — 4 — 2.41 — 30
1899 — 4 — 2.41 — 29
1900 — 2 — 1.20 — 28
1901 — 3 — 1.80 — 27
1902 — 5 — 3.01 — 26
1903 — 2 — 1.20 — 25
1904 — 1 — 0.60 — 24
1905 — 2 — 1.20 — 23
1906 — 2 — 1.20 — 22
1907 — 9 — 5.42 — 21
1909 — 6 — 3.61 — 19
1910 — 6 — 3.61 — 18
1911 — 1 — 0.60 — 17
1912 — 2 — 1.20 — 16
1913 — 1 — 0.60 — 15
1915 — 5 — 3.01 — 13
1916 — 12 — 7.23 — 12
1917 — 5 — 3.01 — 11
1918 — 8 — 4.82 — 10
1919 — 4 — 2.41 — 9
1920 — 15 — 9.04 — 8
1921 — 6 — 3.61 — 7
1922 — 4 — 2.41 — 6
1923 — 10 — 6.02 — 5
1924 — 1 — 0.60 — 4
1925 — 4 — 2.41 — 3
1926 — 6 — 3.61 — 2
1927 — 17 — 10.24 — 1
1928 — 10 — 6.02
TOTAL 166 100%
25.9%, 20 years or more
6.6%, 30 years or more
10 years or more, 51.1%
74.1%
48.9%
93.4%
Length of Service
MACHINES IN ALL DEPARTMENTS
Total Service, years ---------- 2108
Total Machines (exclusive of those purchased during 1928) - 156
Average Years of Service ---------- 13.5

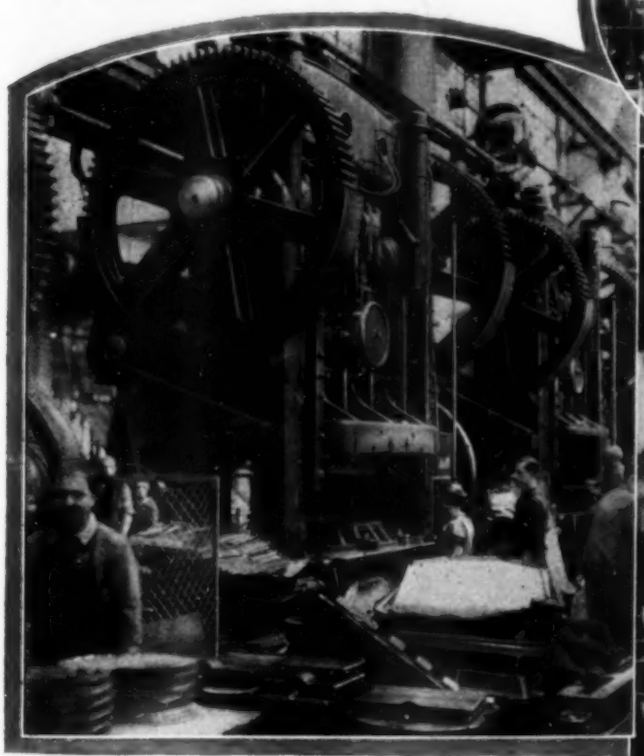
IN GERMANY'S LARGEST AUTOMOBILE PLANT

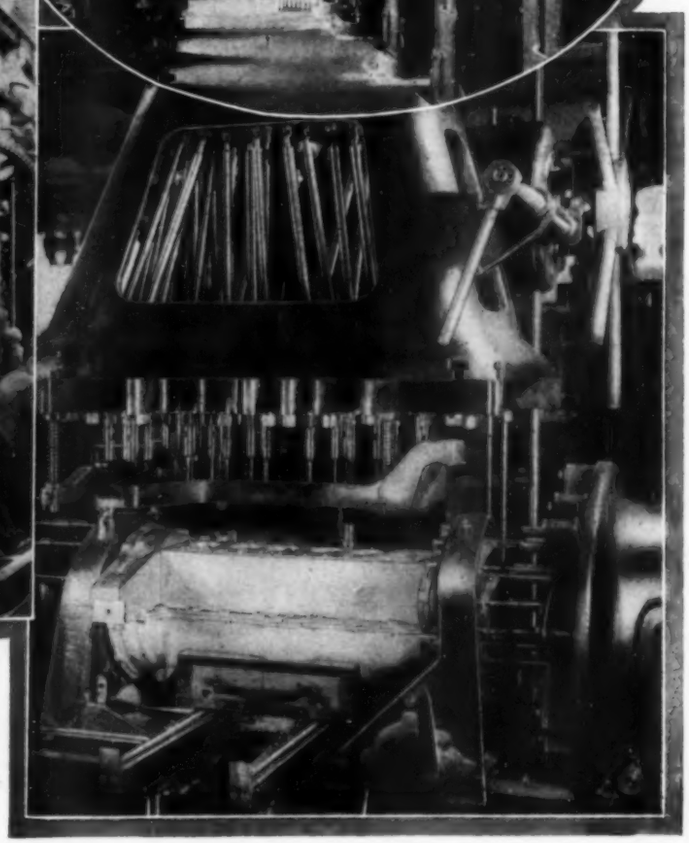
Photographs by courtesy of the Opel Works, Rüsselsheim

One of the best gear departments in Europe. The majority of the machines are of American make, but belt driven

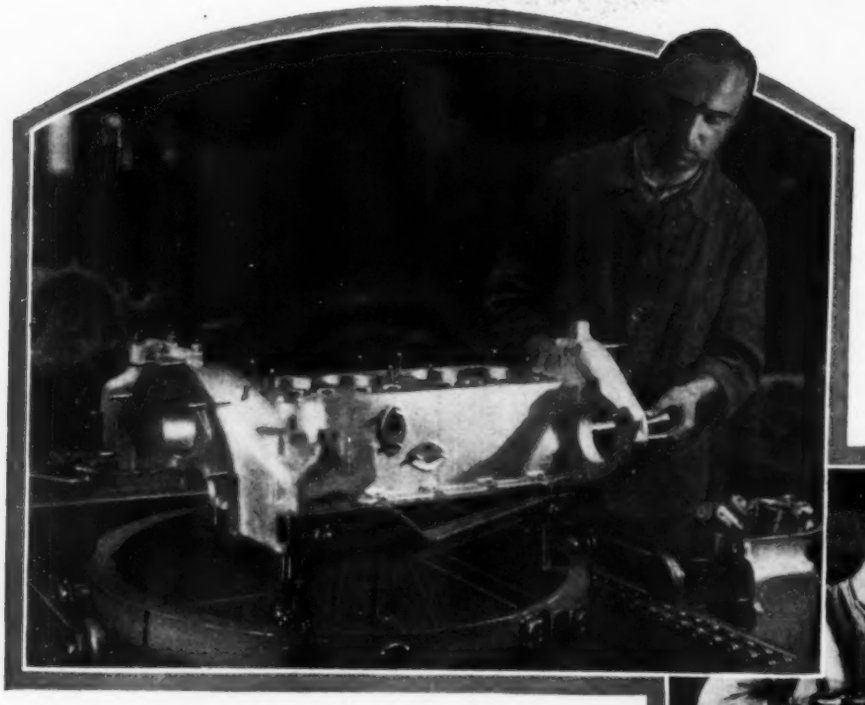


A big body press in operation. Note the centralized lubrication system actuated by the pinion shaft

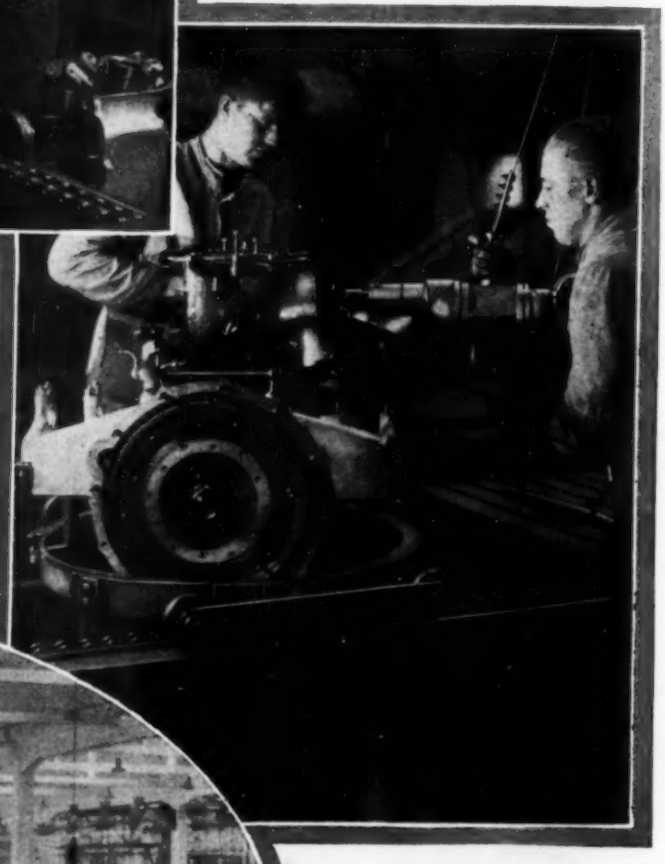




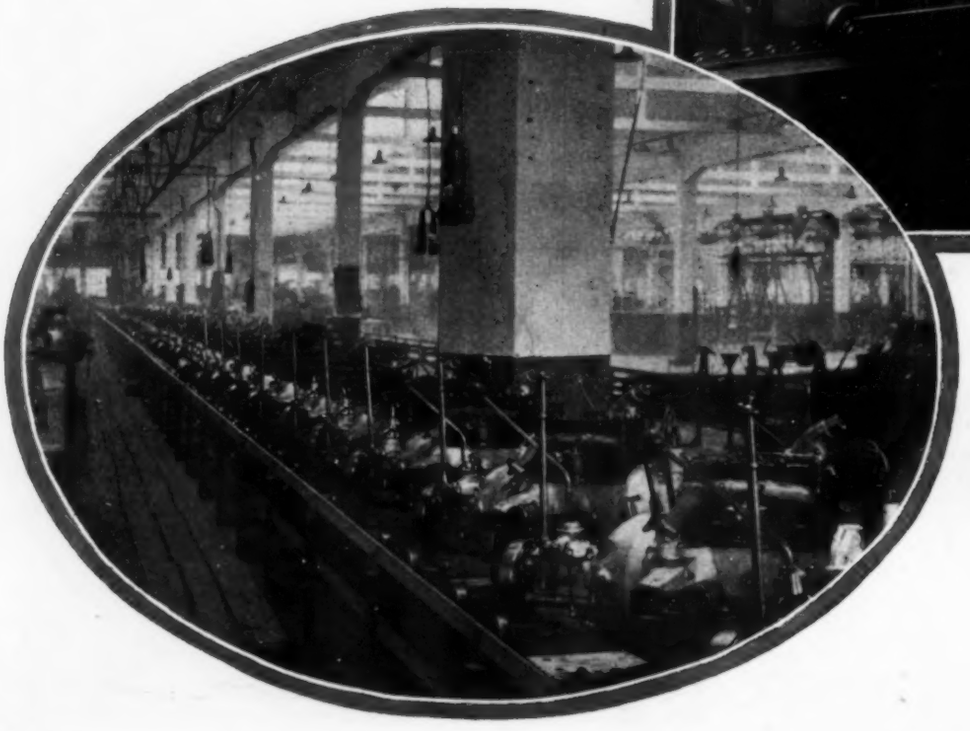
Three-way multiple-spindle drill with 92 spindles. The upper and lower halves of the crankcase are temporarily assembled for this operation



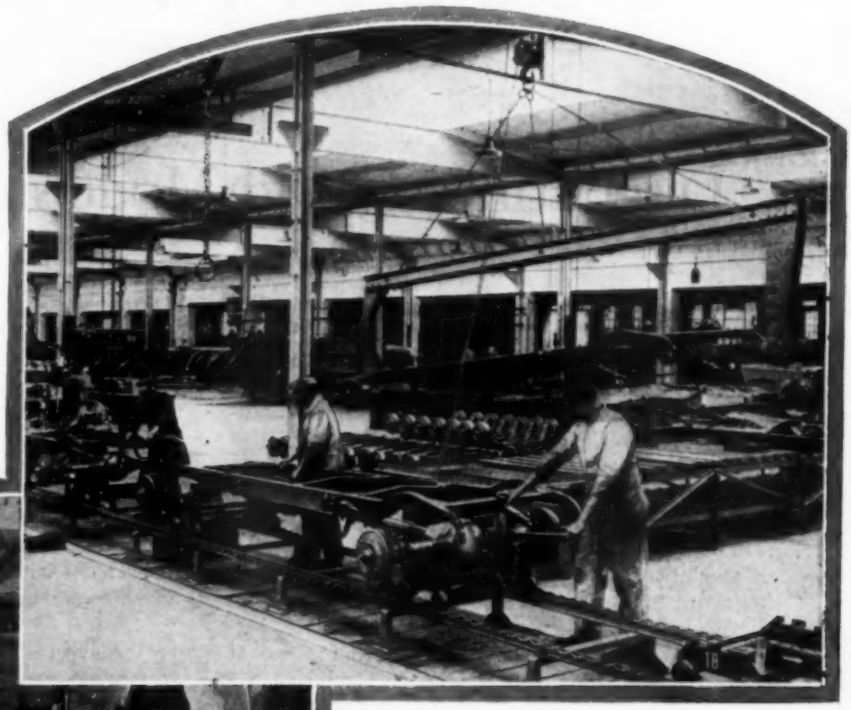
One of the first engine assembly operations. The crankcase upper half is mounted in a rotatable carrier hung in trunnions so that it can also be revolved



Engine nearing completion. The portable nut driver is one of many used all along the line

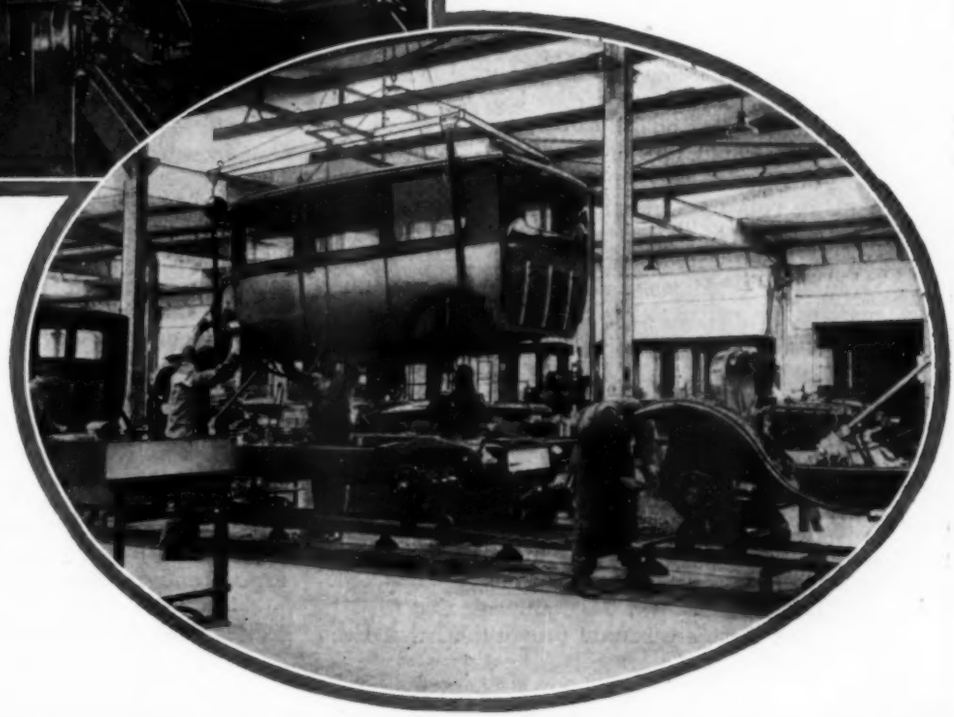


Finished engines reaching the end of the line. The carriers have been turned to let the engines come as close together as possible



The end of the frame line and the beginning of chassis assembly. Front axles are attached before the frame is turned over in the trunnion carrier that brings it to the line

Chassis assembly at the point where the radiators are mounted and the electric wiring is put on. Note the portable tools and their connections



The body is mounted near the end of the assembly line. The contrivance on the side of the body that looks like a spot light is a turn indicator

Discontinuing Old Models of Machines

THERE was a small gathering in the office of the Hooper Thresher Works, by invitation of James Hooper, the president and manager, Frank Faulkner, the salesmanager, Ben Ames, the superintendent. Bill Holland, unofficial listener to all kinds of tales of woe, was also present by special invitation of the president.

"The thing we're anxious about, Mr. Holland," said Hooper, "is when to discontinue old models of machines. Our Model 24 has been on the market about ten years. It's still a good machine, but the newer models, 25 and 26, are, of course, better. We'd like to drop Model 24, but some of our old customers keep ordering in spite of the new machines. They've got used to that model, it evidently meets their requirements, and they order that model in preference to the new one."

"Those old machines are nuisances in the shop, Mr. Holland," said Ames. "We have to keep a lot of old patterns, old gages, and old tools. When we do get an order in the shop, it's naturally small, and it upsets production schedules of our newer lines. The old 24's cost more to build because the men are now accustomed to the new machines, and I'm sure we'd be money in pocket if we dropped the old line entirely."

"You shop men like to work in ruts, I'm afraid, Ben. And you don't appreciate how hard it is to get customers and hold them. The men who buy Model 24 would probably switch to some other make of thresher if we dropped that model. They think in ruts too, and they'd be peeved if they got the idea that we were trying to force them to buy another machine. They would think it was because we could make more money on the new one—as the old model is good enough for them. We can't drop a model cold and force them to buy a new one as the automobile men do."

"How about it, Mr. Holland?" asked Hooper.

"It isn't an easy problem at all, Mr. Hooper, and you are not the only one who is struggling with it. I find it in all sorts of industries. The longer the life of the machine the worse the problem is.

"There doesn't seem to be any rule that fits all cases, but there are several propositions that I've heard discussed. Some, of course, set a date for discontinuing manufacture, and customers can either take the new model or buy some other make. They, of course, try to educate customers to the advantages of the new machine, and sell them on the idea that it has been designed to save them money."

"Seems to me a good salesman ought to be able to do that, Mr. Holland. It's true and it ought not to be hard with well written letters, booklets and ads," spoke up Ben Ames.

"You've no idea, Ben, how people hate to learn to run new machines," replied Faulkner. "They know how the old ones operate, and they hate to learn a new machine."

"That's too true in all lines," said Holland. "I heard of a man who bought two model 'T' Fords before they went off the market, so he wouldn't have to learn gear shifts. But that was an extreme case. Some follow Ben's suggestion and try to educate the old customers by mail and ads. Others notify all customers that certain models will be discontinued after a given time, but that parts will be kept for a certain length of time. Some make up parts for a few machines before discontinuing and only assemble as orders are received.

"And I've heard of cases where they notified all inquirers that machines of the old type could only be supplied as special after a given date. The tap makers, also, found years ago that the best way to eliminate odd sized taps was to list them as 'special,' and charge extra. When you hit the pocket-book nerve, it's pretty apt to jar almost anyone out of his rut. You can't go on building obsolete machines forever, even if some do like them. The question seems to be, *when* and *how* to cut them off."

"I'm inclined to notify customers that model 24 will be dropped January 1, 1930," said Hooper.

Executives are invited to discuss the problem involved in the foregoing case. They are also urged to use this department to air their own problems. A letter to the Executive Forum Editor is all that is needed.

EXECUTIVE FORUM

Discussion

Pricing Repair Parts

The manufacturer cannot afford to carry repair parts for accommodation. The cost of handling is high and therefore the cost to the consumer is high. Sometimes the consumer is not aware of the high cost of handling, and when he has to pay a high price for parts, he thinks the manufacturer is fleecing him. The result is that the next time he buys a new machine he buys from another firm. Then he finds out that the cost of repair parts is just as high and sometimes even higher. Finally he finds out that he must pay a high price for repair parts no matter what make of machine he buys, and he buys the machine that suits his needs.

The only course for the manufacturer to follow is to set a price on repair parts that will bring a profit, and then stick to that price. He may lose a certain class of customers by doing so, but he will break even in the long run because he will gain some of the same class of customers from his competitors. If he has to lose money on repair parts in order to hold a certain class of trade, he would profit in the long run by losing this business. W. J. OWENS.

Preventing Unfair Rejections

I rather disagree that a rejection based on tolerances that have not been met is necessarily an unfair rejection. Tolerances are one of the most significant parts of a drawing, and to figure that a customer will overlook unreasonable tolerances is hedging the question. Despite their importance, they are ofttimes unnecessarily close. It is the duty of the shop to call this to the attention of the drafting room, for despite the fact that they are unnecessarily close at times, there are just enough times when they are actually needed exceptionally close for particular design reasons, that it is unsafe to use snap judgment. The contractor, in the case cited, bears the shop relationship to the purchaser, with the additional disadvantage that he is not always familiar with detail assembly conditions.

The way to have handled the situation at its inception, particularly since it was noted, was to submit two bids. The first, and obviously higher bid for the gears exactly as specified, close tolerances and all; the second, or alternate bid, which was presumably the price quoted, to be accompanied by revised drawings showing the more reasonable tolerances it was proposed to use. Then, the issue would have been met fairly and squarely, and officially settled.

"Noise" is as yet undefinable. But, if you are admittedly wrong in meeting part of the specification, you cannot argue successfully what may or may not be attributed to it as a consequence. But, if you meet the specification fully, noise, not being a part of it, cannot be rightfully introduced as a cause of rejection.

In the case cited, the only course is to offer the gears in question at a price concession, and charge the loss to experience. If they can be reworked, it would be better for future relationships to do so and accept the extra cost as a loss. An impartial engineer, while rendering a fair decision, may still lose you your customer, and that should not be risked, if business reputation is valued. —EARL L. FAIRALL.

The Price Per Pound

The question of preparing estimates in reply to inquiries, a considerable number of which never materialize in orders, is a sore point with all firms that build special machines. No matter what happens, an estimator is usually thought guilty either of spending too much time on profitless work, or of careless estimating on jobs that do materialize. Any method that will safeguard against either fault would be a Godsend.

If Franklin finds the price per pound method satisfactory for certain classes of machines, I congratulate him and suggest that he keep it to himself. I do not believe that any such method is sufficiently free from trouble to be safe in the hands of a salesman. Only the estimator who made it can know enough about it to use it with safety.

The only method, which I have been able to evolve, is to analyze the cost of the different more or less standard assemblies and parts and group them accordingly. Roughly these groupings are: Semi-standard assemblies, such as reduction gears, clutches, and similar assemblies; small parts, such as levers, brackets, and handles, and machines requiring experimental work covered by special estimates.

The proportion of total cost falling into the three classes may be in the order of 50, 40, and 10 per cent, respectively. But these percentages are of no use to the salesman, for it may happen that, when stock patterns can be used, differences in price and delivery will be involved.

Sorting out inquiries and dealing suitably with each requires some second sight as well as foresight and psychology. In some cases the best method is to send a rough estimate, pointing out its limitations, and offering to go further into the matter if necessary. Straightforward people are usually attracted by straightforward methods, and the other sort are not often worth dealing with. —H. JAMES, *England*.

Six Hundred Carloads of

Milling Machines Made from Standard Units

and No Two Machines Alike

By E. J. Kearney
Secretary and Treasurer, Kearney & Trecker Corporation

MACHINE tool users, writing for the *American Machinist* under the title: "Getting the Most Out of Your Machine Tool Dollar," have, in some instances, specified a maximum of one year as the length of time in which a new tool must be able to pay for itself before its purchase would be considered. Undoubtedly these writers, consciously or unconsciously, have had their judgment affected by consideration of possible changes in the design of their own product. There can be no doubt that the tendency toward frequent change of design in most American products is on the increase, in spite of pleas for standardization to favor mass production. The force which is driving in that direction is the demand for greater and greater sales, in order to attain low production costs through volume of turnover.

The machine tool builder must adjust himself to these changing conditions even though in so doing he is deprived of some of the comforts of the older order. A generation ago, the name "Machine Tool Builder" was a proper title. One or two draftsmen supplied the shop with all the needed drawings for the lathe, milling machine, or drill that was turned out with fair regularity in dull or boom times if finances permitted. Today, the title "Machine Tool Engineer" would be more appropriate. The inconspicuous drafting-room of twenty-five years ago has become an important engineering department, with as many employees in the larger establishments as were formerly to be found in the entire average shop at the beginning of the century. These engineers are engaged in advancing the design of standard machines, designing special machines, adapting special attachments to standard machines and planning holding fixtures and production methods for their clientele. The designing and building of special attachments for standard machines has become of increasing importance, because of the user's desire for salvage when the design of his product changes, perhaps next year or the year after. In view of the varied requirements to be met, leading in many cases to special machines throughout, it is not surprising that machine tool engineers have turned their attention to producing standard units, out of which a variety of machines can be made. Under such a plan, standard units are selected and combined with one another for ordinary requirements, or a special one added, if necessary, to meet unusual conditions. By this method a variety of general-purpose machines, or even special single-purpose machines, can be produced in such a way as to realize the advantage of jigs, fixtures, drawings, and patterns throughout the greater part of their construction. Instead of building machines in lots, as formerly, units are made in lots and assembled according to demand.

Such a system of designing leads to economy and makes it possible to shorten delivery by having in stock, or in process, the necessary standard units to meet varied requirements. Delay other than the time required for assembling comes only when a special unit must be furnished, in which case the unit may be semi-special only, being so classified since it is not repeated often enough to be carried in stock or to warrant the expense of jigs and fixtures for its construction. In the event of a design change in the user's product, units, standard or special, can be substituted to meet the new conditions, thus making it unnecessary that the entire machine pay for itself in a single season, as some have specified. In the milling machine of many combinations, called by its builders the "Mil-Waukee-Mil," the engineers of the Kearney & Trecker Corporation have constantly kept in mind the idea just set forth. Some typical combinations of standard and special units of the machine are used to illustrate the principle of design employed in an effort to

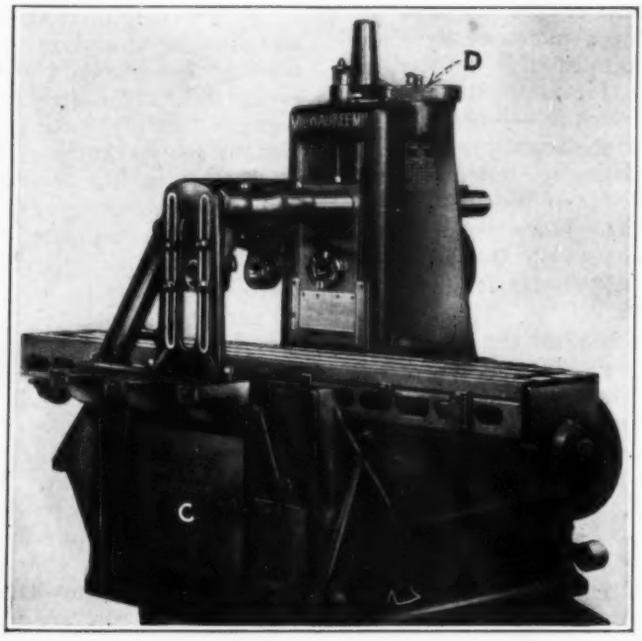


Fig. 1 — Unit combinations start with a bed that has suitable ways cast integrally to accommodate the work table and either one or two spindle heads as desired

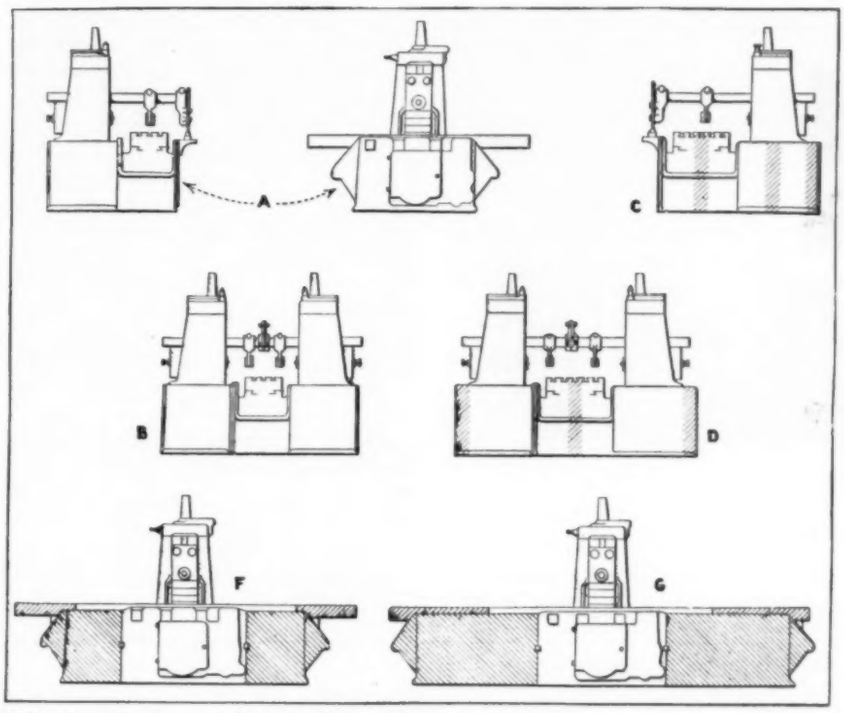


Fig. 2 — A group of beds including those for wide and narrow tables, and for short or long tables, as applied to either single or double-spindle machines. The sectioned areas indicate the variations in dimensions

reach this ideal. No attempt is made to claim originality for this type of construction; only for its adaptation, on an extensive scale, to the milling machine. It is well known that builders of multiple-spindle drills make up combinations of columns and heads out of stock, and lathe builders have always been able to furnish beds of varying lengths, to which standard heads and tailstocks are attached. Builders of other types of machine tools, including milling machines, can undoubtedly point to progress in the same direction. It is believed, however, that the idea has been carried farther in the design of this machine than ever before.

The beginning of the unit combination is to be found in the bed, which is cast in one piece with two sets of ways at the top at right angles to each other, one for the work table and the other for the spindle head of various design, standard or special. The construction may be seen in Fig. 1, which shows a machine with a single-spindle head. The bed is made to carry one spindle head for the Simplex design, illustrated at *A* in Fig. 2, or two spindle heads for the Duplex design, shown at *B*. For both the Simplex and Duplex models, the beds are cast in two different widths to accommodate narrow or wide tables, and to provide for greater or less space between the spindle heads. At *C* and *D* are shown these models with the wide tables. The beds are also made in such a way that extensions can be bolted to either end to support longer tables where longer feed is required, such as outlined at *F* and *G*. These beds, whether Simplex or Duplex, with or without provision for extra widths or lengths, are all made with the same set of production tools.

To the bed are bolted the primary units required for control and operation of the machine. One of the units is a pulley, carried by a bracket containing a multiple-disk friction clutch and a brake. The belt guard that covers the pulley, as illustrated in Fig. 3, is for motor drive, with the motor in the bed as shown. The construction can be replaced by another unit for lineshaft belt drive.

Another unit carried by the bed is the feed-change mechanism, consisting of pick-off gears, shown at *A* in Fig. 4. This system of feed change is for large production, where the set-ups are infrequent and few changes of feed are needed. However, on classes of work where the runs are short, or frequent changes of feed are required, a quick-change feed unit is supplied, as shown at *B*, Fig. 3. Then, where the nature of the work makes automatic or intermittent feed control for the table desirable, another unit is available, shown in Fig. 1 at *C*, which is attached to the bed behind the door.

In connection with automatic feed control, another unit is available for stopping the spindles automatically when not actually cutting, or at any desired point in the cycle.

A reservoir is cast in the bed for cutter coolant, and a circulating pump is provided, or not, as occasion requires. These combinations, in brief, outline the foundation bed of the machine with its operating units.

What may be called a primary spindle head is shown in Figs. 1 and 4, in which the spindle drive shaft rises from the bed inside of the head. The shaft runs at approximately pulley speed and carries the power to the spindle speed box *D*, Fig. 1, located at the top of the spindle head. The box is made in two styles, one for pick-off gears for production jobs, where the speed changes are infrequent and the set-up time not important; the other is a quick-change gear box, to be supplied where the machine is to be used on shorter runs, or where greater convenience is a factor. The speed boxes are interchangeable on the various styles of spindle heads, standard or special.

The construction of a vertical spindle head that may

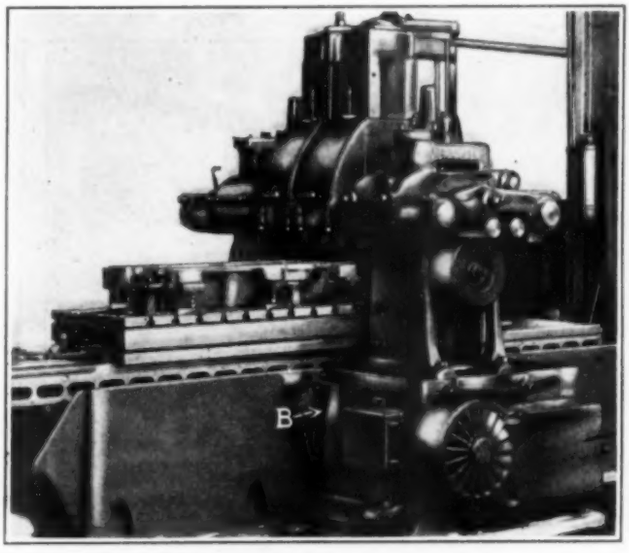


Fig. 3—A triplex machine, having two vertical spindles and a quick-change feed unit for work requiring frequent feed changes

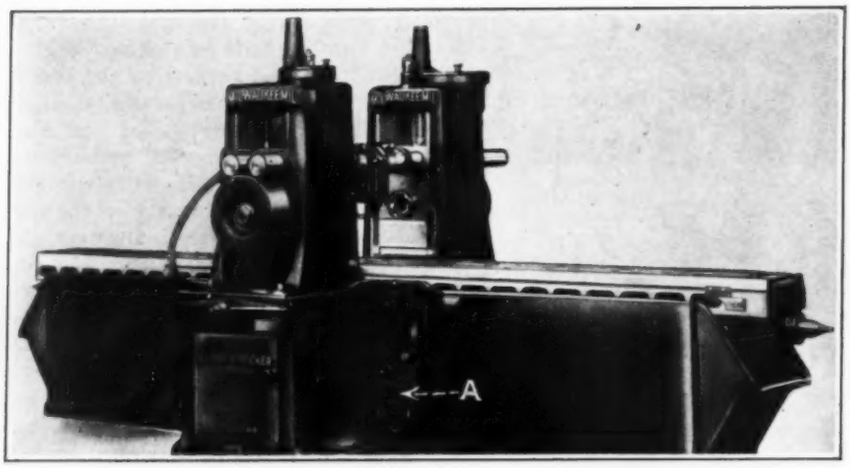


Fig. 4—A Duplex or two-spindle machine, arranged with pick-off gears suited to work produced in large quantities. The table is of the long type corresponding to the arrangement at G, Fig. 2

A Triplex model is shown at *D*, *F* and *G*. This machine is built up through the addition of the shaded units from a Duplex machine, having either horizontal spindle heads of primary construction, or horizontal heads of other standard or special construction. Interposed between the speed boxes and the top of the horizontal adjustable heads are blocks that support two steel bars, to which horizontally adjustable heads are attached, carrying rectangular rams or vertical-spindle blocks. The construction of the Triplex is such that the machine can be used as a Duplex for face, slab or gang milling without interference from the vertical spindles, and all may be used simultaneously when desired. The vertical spindles are adjustable from a distance close to the top of the table to the extreme working height of the machine.

be interchanged on the bed with any other head, and which is just as much standard as the so-called primary head, is shown in Fig. 5 at *A*. The speed box is similar for both machines and may be either of pick-off gear or quick-change speed type as desired. At *B* is shown another standard construction in which two horizontal spindles are furnished, one above the other. These spindles are adjustable to and from each other, and both are independently adjustable in a vertical direction. One of the spindles has an end adjustment independent of the spindle block, the other is adjustable endwise only through movement of the entire head to and from the table.

Another standard head known as the Broadside is illustrated at *C*. The spindle is non-adjustable in a vertical direction. The cutter, a large face mill, is driven by an internal gear, to which it is directly keyed and bolted.

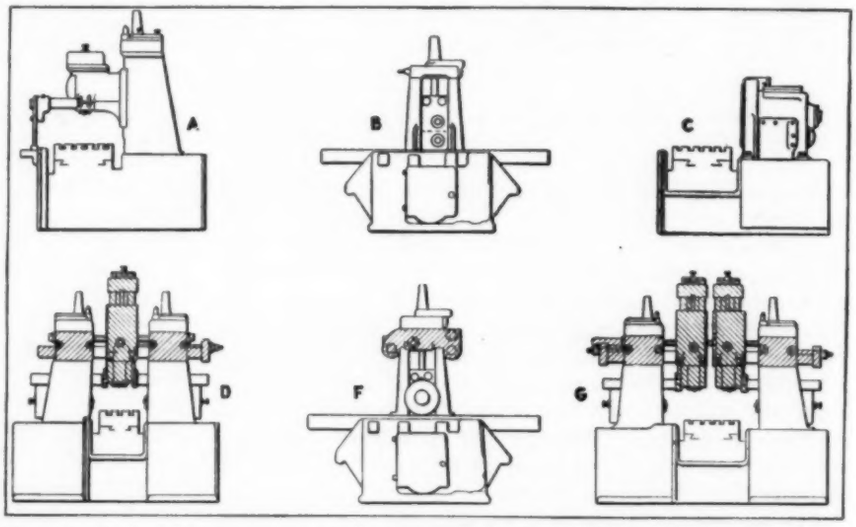
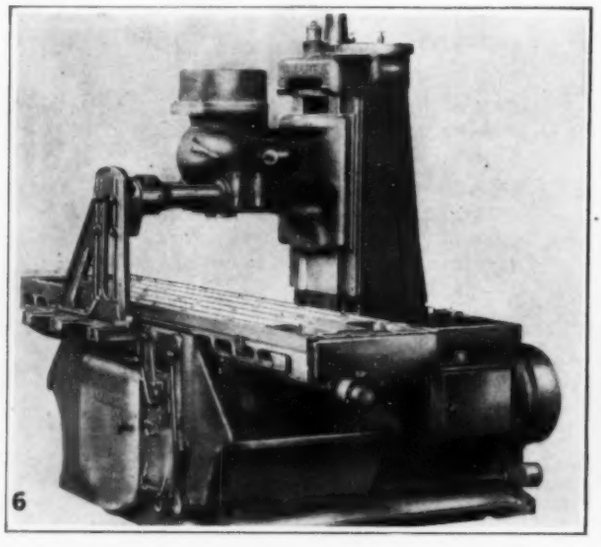


Fig. 5—Various combinations of horizontal and vertical machines arranged with independently adjusted spindles, and with quick-change or pick-off feeding units



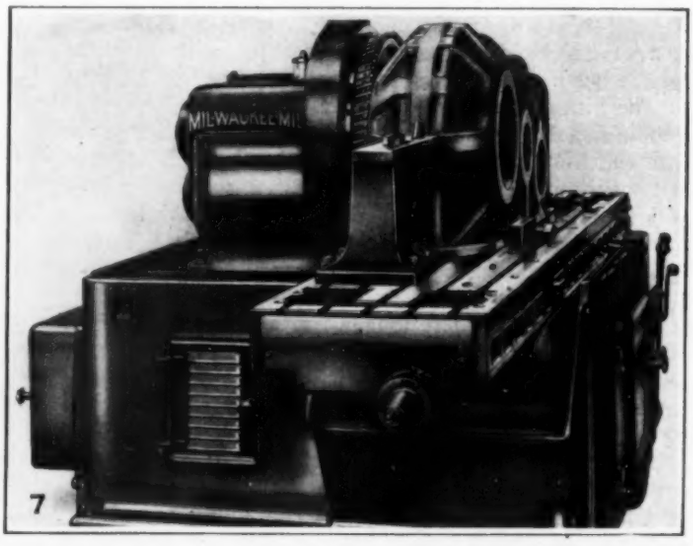


Fig. 6—A single-spindle vertical machine with a wide work table. This machine is made by adding a vertical unit to a horizontal machine. Fig. 7—By applying a "Broadside" head, large surfaces can be face milled as shown

When in the lower position, the rectangular spindle rams are supported by the over-arms in the horizontal spindle blocks, T-slots in the rams making this support possible. Each horizontal and vertical spindle can be adjusted either horizontally or vertically without interfering with the adjustment of any other spindle. The entire range of spindle speeds is available for any one of these spindles, independent of the speeds of any other spindle. The vertical spindles use the same pick-off gears as the horizontal spindles but are not arranged for quick-change speed box.

Further examples of some of these points may be made by reference to Fig. 3, which shows a Triplex machine with two vertical spindles; Fig. 6 which illustrates a vertical-spindle machine; and Fig. 7 a machine equipped with a Broadside or large face mill.

Thus far, nothing has been described that is not regarded by the makers as standard, interchangeable equipment. Out of these standard units, over two thousand different and useful combinations can be effected, and there will be no machine in this entire number that does not differ materially from every other machine.

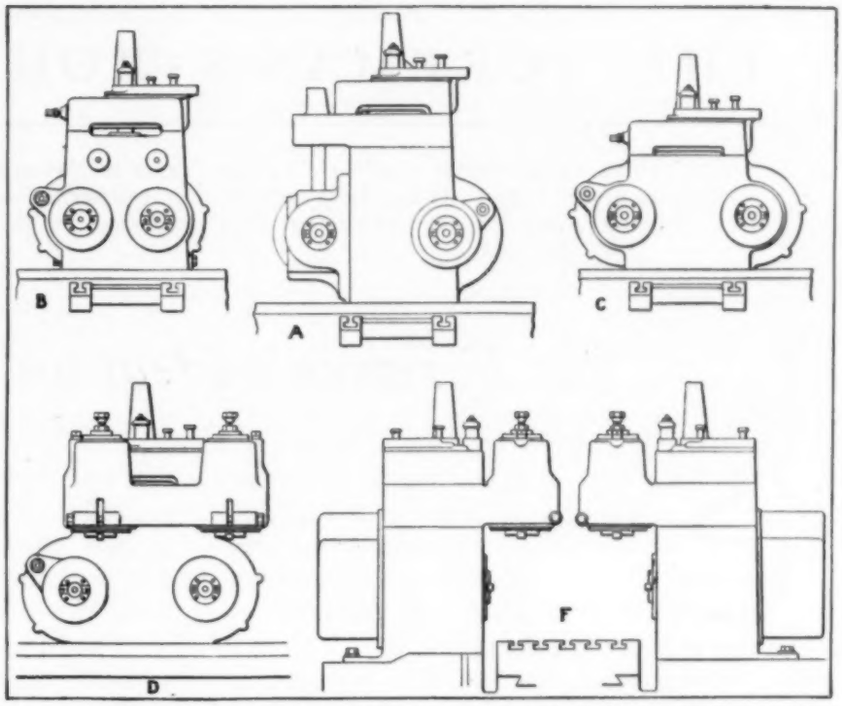


Fig. 8—Typical examples of special and semi-special spindle heads that can be applied to standard beds, and which are suited to a combination of horizontal and vertical milling

Special or semi-special spindle-head units can be made in endless variety. Some typical examples are illustrated in Fig. 8, a two-spindle head being shown at *A*. The spindle at the left is constructed to move automatically in a vertical direction at a predetermined point in the cycle, in order to avoid a projection on the part being milled. At *B* is shown a two-spindle head with the spindles running in opposite directions for gang milling on short work, the work being loaded first at one side and then at the other.

A double-spindle head arranged for roughing and finishing is shown at *C*. This head may be regarded as semi-special and is also to be seen in the illustrations at *D* and *F*, in which case it is supplemented with a vertical-spindle carrying block, located between the speed box and the horizontal spindle head. These spindles are in tandem pairs for roughing and finishing. The combination is shown in use in Fig. 9, the spindles in this case totaling eight.

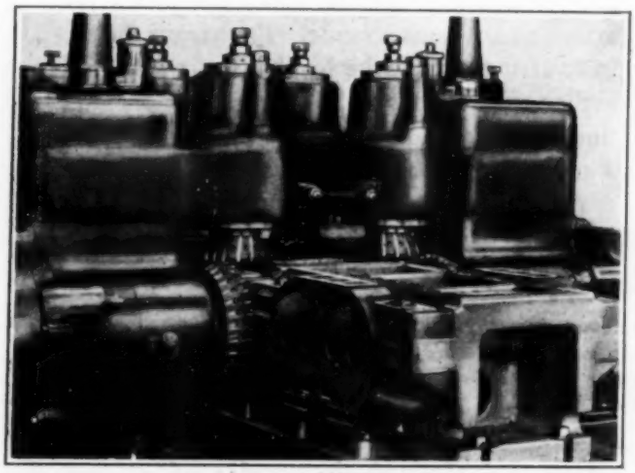


Fig. 9—A combination horizontal and vertical machine with eight spingles, arranged in tandem for rough and finish milling parts in quantity lots

In addition to the special spindle heads to which reference has been made, attachments can be supplied to the primary spindle block and the double over-arms in much the same manner that attachments are applied to knee-and-column-type machines. These units can be removed at the will of the owner, and the machine used as a primary standard.

It is apparent that given the foundation bed, with its necessary operating units and a speed box of selected construction, possible developments in the space between the speed box and the bed are almost limitless.

It has been the desire of the writer to convey his opinion as to the trend of conditions surrounding American mass production of the future, and how the machine tool engineer can best meet those conditions. There is a tendency toward more frequent change in design of most American products, as stated in the beginning. We are in an era of progress. How far we shall go no one can guess, for the pace at which we are progressing is accelerating rather than retarding. Not the least of the factors involved is the machine tool engineer who will be found adapting his product to the widening stream of industrial production, and thereby making his contribution to the prosperity of the future just as he has to that of the present.

Wages and labor cost of product are frequently found to be in inverse ratio. Wages in the United States are about twice as high as in Europe, and yet the labor cost of producing steel and other products is considerably lower in this country. And the higher wages make better customers of the workers, and so enlarge the markets.

· THE · FOREMAN'S · ROUND · TABLE ·

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

The Foremen's Ideas on Pensions

"STAYED late last night, and rode home with Williams," Al confided to his fellow foreman early one morning. Ed knew something unusual was coming from Al's manner and discreetly remained silent for a change.

"Williams said the board of directors is seriously considering the matter of establishing some sort of pension system for old employees, and he asked me my opinion of it."

"I hope you told him that a pension system is too much like charity for the men to take kindly to it, Al. If they have extra money why don't they pay higher wages?"

"I'll admit that a pension plan in which the company puts up all the money does seem like charity, but you know lots of them are worked with contributions by both the men and the company. That's the kind we were talking about, Ed.

"Besides, lots of the big companies are going in for them these days. Maybe a man ought to save for his old age, but the fact remains that with sickness, bad luck and unusual demands, many a man just can't accumulate the necessary reserve by himself."

"Well," Ed came back, "if the men contribute to the pension fund, you have to provide for returning their accumulated money to them if they leave before they are pensioned, don't you?" Receiving an appreciative nod from Al, he continued, "I'll bet if you tell them of such a system they'll all plan to quit right before their pension becomes effective, and take the lump sum of cash, which would look mighty big to them."

"They'd say that now perhaps, Ed, but when the time really comes and they are old and facing an uncertain future, they'll think better of it. They'll stick for the assurance of the pension, which will not only represent their money but also the firm's contribution."

"Suppose you do vote for a pension, Al, where do you suppose the company's money will come from? It looks to me that in ten or twenty years from now it would take a lot."

"Well, when we buy equipment and machines we set up a depreciation fund to take care of its replacement when it wears out, don't we? The Board of Directors will have to provide a depreciation fund for the human element just as they do for plant and equipment."

"You make it sound mighty reasonable, Al, but I'm still dubious about the men's reaction to any such scheme. I'm afraid they'll look at it through the bright eyes of to-day, rather than through the dim grayed ones of their distant old age, and think it is somehow a means for the company to get the use of part of their wages from them."

Contributed by N. Richard

Al has been put up against a serious question. Is he right in reporting back that the men would like to contribute to a pension fund? Or, is Ed right that the men prefer to handle their own savings? Is there any other solution?

All foremen are urged to discuss these questions vital to their work; of course the

discussion is not limited to foremen. Letters accepted and published will be paid for

Discussion of Earlier Topics

Making Foremen—or Importing Them

THE principle that foremen or other executives should invariably be chosen from among the employees, preferably those with the longest service records, is so firmly established in some shops that the men in each department come to regard the man who is oldest in point of service as the inevitable successor to the head of the department. What incentive is there, then, for the young fellows in that department to show what they can do? And what incentive is there for the "heir apparent" to do any more than just enough to keep his own mistakes covered up? This automatic promotion policy drives away the younger man with ideas and ambitions, and attracts the plodder who is content to do only what he is told.

The proper basis on which to choose an executive is not length of service nor excellence as a craftsman, but executive ability; the ability to direct the work of others and to get things done. If such a man cannot be discovered in the department where the vacancy exists, he might be found working in some other department of the plant, and would bring to the job a somewhat broader experience. Managerial ability may crop up in diverse places; one of our department heads was taken from the chemical laboratory, and another from the toolmaker's bench. —CHARLES SPRAGUE HAZARD.

IT IS my firm belief that the only consideration to be given to the choice of a foreman is that of ability. If, in the opinion of the owners, a man in the shop has the ability, he should get the job. Otherwise, search outside must be made. No successful leader can be made of one who needs constant nursing along, as the men lose confidence, and he becomes the butt of all mistakes. The only fair play needed to satisfy the men in the shop is that the men selected in any case be more competent in foremanship qualities than any of them.
—CHAS. H. WILLEY.

A Chance to Grow

THAT every man should have a chance to grow is a doctrine to which politicians of nearly all parties, and industrialists both in America and in Europe would publicly subscribe. But in practice, the path along which growth may take place tends to become something in the nature of a bottle neck. In Europe the educated mechanic knows America as the land of Carnegie, Schwab, Ford, and Steinmetz, and it is generally believed that in America such rises to fame and fortune are more possible than in Europe. But to take England alone, it can be shown that the growth of the Morris and the Austin automobile concerns, for example, is very similar to that of Ford and General Electric.

On the average, 90 per cent of the employees of the most successful American mass production concerns are classed as unskilled: that is, they do jobs which can be learned in a day or in some cases in an hour, although they may be done by immigrants who have learned a skilled trade in Europe. To compensate for the deadly monotony of this work he has the advantage of fairly good wages and all kinds of welfare schemes.

The ideal of the progressive European manufactures is a similar kind of factory and as far as he can afford it he provides the welfare schemes. Some employers prefer to recruit their executives from the ranks of the skilled mechanics, and look only for ability, but many of the older established firms in Europe train the sons of the directors for the best jobs, and even the foremen are recruited from the ranks of their school-friends, or from the poor relations of the directors. There is something to be said for this policy, but it does stultify ambition and cause dissatisfaction, particularly among skilled workers. —H. JAMES, *England*.

Asking a Man to Come Back

IF FRANK was bawled out for something he didn't do he cannot be blamed for being a bit uppish about it, and if Ed had been a good foreman he would have looked into the matter first before taking action, and found out who really had been at fault. So it is only right that he should call Frank back. The latter will know that Ed is square, and he will also know that he has a just foreman and will respect him more. —EDWARD PIRINIAN.

OF COURSE, Ed should never have made the hasty decision, but having made it, I rather believe it is better for all concerned for him to stick to it. Since there is no uncertainty about the fact that Ed did make a mistake, he should try to make amends, but not by asking the man to come back. If Ed knows of any position open, he should see that the information gets to

THE · NEXT · TOPIC

More Responsibilities for the Foreman

ADVANCE QUESTION

Williams has made it a rule that foremen must check the accuracy of the first piece of a run and be sure that blueprints and fixtures are O.K. Ed thinks he's asking a lot of foremen. Al thinks such duties are the foreman's job. What do you think?

the man he fired. Among his personal friends he can make an inquiry as to any who might want such a man, and when he ascertains a need, tell the story frankly to the prospective employer. In other words, he should do everything possible for the man, except to offer to take him back. —James P. Connor.

Handling the Shop Office

A FOREMAN who handles all things himself is wasting his own and the company's time, spoiling it with questions without value. He has to choose his clerks and assistants in such a manner that he can rely upon them. If he has not the right man in the right place, it is fault of himself and he has to change it. He should instruct his clerk in such a way that only things of interest will be reported to him, and only things of importance will come through him. He ought to see or sign all requests for non-productive expense, all time of men working on non-productive orders, or on lost time, in short all things affecting the quality, quantity or price of the products for which he is responsible.

—M. L. J. Jochem.

Equipment and the Foreman's Reputation

RECENTLY I had occasion to analyze a plant where power was supplied by a steam engine. This engine was rather old, yet no one seemed to know whether it was operating efficiently. The engineer told me that he made repairs as they were needed.

I kept records, for six months, of the repairs made on this engine. When these records were complete, the management was surprised to find that the engine was costing as much for repairs in a year as would buy a new engine. —Robert Mawson.

Finding New Ideas on Shop Visits

THE foremen and the company both benefit by the contact secured through the medium of inspection trips, the company through securing new ideas on shop problems and method of doing work, and the foremen in getting new angles on questions relating to their own work.

Observing the layout of machinery in the plant being visited, and the merits of such an arrangement as compared with the machine layout in their own plant, will give the visiting foremen a good viewpoint on the most suitable arrangement of the machines for performing the work.

Management and labor both stand to benefit through observance of the other man's way of doing things, and by securing outside viewpoints on similar problems.

—M. Buswell.

The Boss's Son in the Shop

AS A boss's son who learned his trade in his father's shop, I would advise any boy against starting an apprenticeship under such a handicap.

It is unfair to the boy to allow it, and we can predict that he will not have a happy lot. Conditions will be made unnecessarily difficult if his father is sincere in his attempt to put the boy entirely on his own. We can expect foremen to "treat him with kid gloves," being over-tactful at times when they might like to be more severe. This must cause a lessening of respect, each for the other.

Possibly a more important feature will be the attitude of his fellow workmen. Even though the boy is the most likeable chap in the world we may expect some strain between them, such as when one person feels that another is not quite sympathetic. Did you ever see the boss's son try to join a group of his fellows at the noon hour? As he approaches conversation suddenly ceases. It is a trying situation to put any boy into.

—E. F. Nelson.

TO GET his training in his own father's plant, is neither essential nor logical. No matter how specialized the industry, there are always related industries, if not direct competing industries, in which experience can be gained. True, executives under whom the son might be placed, can and will carry out his father's instructions respecting no special favors. But, with the men in the organization, this is bound to be difficult. They will favor him, be afraid of him, and refuse to take him into their confidence to the extent of accepting him fully as one of their number. Though they may even grow to like him, despite his handicap of relationship in winning their liking, they will always permit their respect to interfere with a normal relationship.

—Joseph H. Cheesman.

Does Appearance in Tools Count?

APPEARANCE in tools does count a great deal, for the simple reason that all of us will stop and admire a thing of beauty. The operator in the shop will judge it by its appearance, and if it is sloppy looking or poorly designed, the operator will not be very fussy how he handles it, nor will he pay much attention to clearing away chips that may accumulate in it.

On the other hand, send into the shop a well designed jig of good workmanship and watch the result. The foreman is pleased, and the operator instinctively looks at it with respect and treats it accordingly.

Jigs should be finished in accordance with the accuracy required. Unnecessary finishes should be eliminated whenever possible, but appearance should be taken into consideration in designing and making jigs. Of course, no one is going to demand that when parts are composed of castings, that these be finished all over, but jigs can be designed and made of good appearance, almost as cheaply as those that are not so.

—Charles Bradford.

Holding Back on Piece Work

OPERATORS in piece-work shops do not turn in their full output on good days because they fear that the rate will be cut, or that the management will demand that every day be a good day. If the rate is fair, they should be encouraged to produce more than a normal day's production, because the more pieces they make, the more money the company earns. If this encouragement is in the form of more pay, and the men are convinced that there will be no attempt to make them work just as hard for less money there will be very few parts held back. The operator is responsible for part of the saving in time and should receive the benefit of that saving for a definite period. —H. G. Kling.

Valve-Motion Maintenance

By Fred H. Colvin
Editor, American Machinist

Methods used in one of the leading railroad shops, and a mention of the practices in other shops—Trend is toward standardized replacement parts

MAINTENANCE of locomotives, rolling stock and other equipment is the primary object of most railroad shops in this country, as comparatively few build either new locomotives or cars. This situation in many cases prevents the reduction of costs by the employment of manufacturing methods as is done in shops where new equipment is built in quantity. In the maintenance of some parts, however, such as the valve motions of locomotives, with their numerous bearings, some of the larger railroads have adopted standards for pins, bushings and similar parts that enable them to materially reduce the cost of repairs on these parts. This standardization permits the making of such parts in quantities of sufficient size to bring about lower production costs and also to enable new pins and bushings to be secured in less time, which aids in reducing the time the locomotive is out of service. Much thought has been given this problem as will be seen from the manner in which standards have been worked out and the fact that replacements are now available at short notice. One leading road has favored us with the details of its system and enough detailed dimensions to serve as a guide for any railroad that has not as yet adopted standardized methods for handling these repairs. Pins and bushings are now manufactured in the large, central shops of the system and shipped to repair shops as needed. The general method is to finish all parts possible, to case-harden and grind the bearing surfaces where this can be done, but to rough machine such parts as must be fitted at the time of application. Parts that must be hardened after the final fitting are frequently carburized at the central plant so as to require only heating and quenching after the fitting has been done.

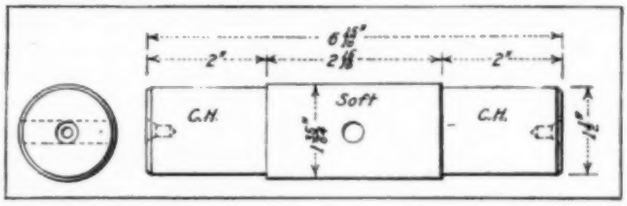


Fig. 1—Valve stem cross-head pin. These are case hardened on the ends and left soft in the center. The hole for the taper pin is drilled before the pin is hardened, then each end is capped to keep it from hardening. The hole is reamed after the pin is driven in place

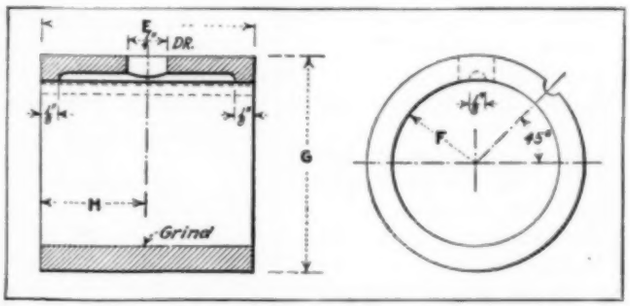


Fig. 2—Bushing for valve stem pin. The inner or bearing diameter is maintained while the outside diameter varies according to the wear of the hole into which it fits

Practice naturally varies on different railroads. The large road in question, however, uses the plan shown in detail in connection with the valve stem crosshead pin. Drawings of both the pin and the bushing are given in Figs. 1 and 2 with the permissible variation in the outside diameter of the bushing.

The pins are of open hearth steel with the ends case hardened and ground to the standard size of $1\frac{1}{2}$ in. The central portion is left soft and turned to $1\frac{3}{4}$ in. In applying the pin the central portion is ground to a light drive fit in the lap and lead lever. In drilling the cross hole for the No. 8 taper retaining pin it has been found better to drill the hole before the pin is hardened, to cap both sides of the hole to keep it soft and then ream the hole after the pin has been driven in place.

Bushings are made as shown in Fig. 2. The bearing diameter is maintained at 1.508 in. when new, giving a clearance of 0.008 in. for lubricant. The outside diameter of the bushing starts at 1.817 in. and is carried in two oversizes, $1\frac{7}{8}$ and $1\frac{1}{16}\frac{3}{3}$, to be used when holes in the lap and lead lever wear oversize. Instead of the worn hole being just cleaned up, it is reamed to the next oversize and a new bushing inserted. The bushings, also are of open hearth steel, case hardened and ground to the size given. They have an oil groove and oil hole, as well as a slot for a dowel to keep them from turning in the lever. Case hardening is $\frac{1}{16}$ in. deep as a minimum, in all cases. A valve gear jaw bolt is shown in Fig. 3. It also is of open hearth steel and case hardened to $\frac{1}{16}$ in., except on the threaded end. The taper of each end is 1 in. in 12 in. Standards have been adopted for the various classes of locomotives, but one size will show the method used. The total length of the bolt and of its various parts, of course, remains constant. The diameters, both of the tapers at the ends and of the plain bearing in the center, vary as the mating parts wear. It is intended to increase the head size so that the large diameter of the small end is about equal to the pin diameter in the center.

If, as sometimes happens, the tapered bearing *A*, in the jaws, wear first, the first oversizing enlarges them while the central bearing *B* remains the same. The tapered portions are measured from the large end; thus the diameter of both taper portions is controlled if the correct taper is maintained. Fit is secured by inserting the standard taper reamer to the same point each time.

On one of the larger locomotives the diameter at *A*

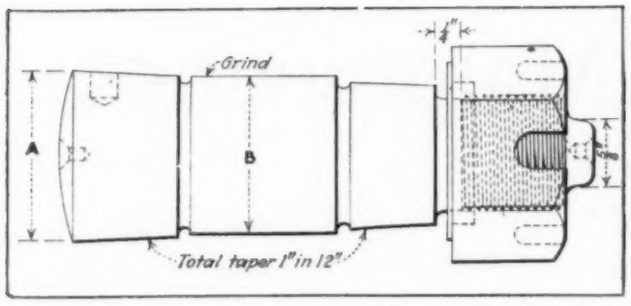


Fig. 3—Valve gear jaw bolt. All diameters are increased as the bearing and taper seats wear. It is intended to increase the head size so that the large diameter of the small end about equals the pin diameter

starts at $2\frac{1}{4}$ in. The second size is 2.338, the third 2.401, while the fourth and last is 2.463 in. Experience has shown that these steps give metal enough to take care of normal wear between shoppings and without permitting an amount of lost motion sufficient to seriously affect the operation of the valve mechanism.

The fit diameter of the pin on the bushing is 2 in. when new. This diameter is maintained on the first oversize, or replacement bolt. By the time the second replacement bolt is needed, it has been found that the bearing *B* is likely to be worn beyond the desirable point; consequently the bolt with a large end diameter of 2.401 in. has a bearing diameter of $2\frac{1}{16}$ in. and the next size increases the bearing diameter another $\frac{1}{16}$ in., making it $2\frac{1}{8}$ in. in diameter for the pin with a large end 2.463 in.

A somewhat similar pin, Fig. 4, is used in the link block, the difference being that there is no nut on the end, the pin being held by a taper pin at each end, as shown. Here again the taper is 1 in. in 12 in. on two sizes of pins while one size has a taper of $\frac{3}{8}$ in. in 12 in. for four classes of locomotives. As before, the pins' diameters are measured only at the large end of the taper *A*, and in the bearing *B*. These pins, however, are hardened only in the center, the ends being left soft, so that they can be drilled and reamed after being driven in place. All diameters are left rough for finishing at the point of application. Equipment is provided for grinding both the tapers and the straight, central portion of the pin when the pin is applied to the locomotive.

On new pins the large end of the taper is $\frac{7}{8}$ in. and the straight bearing is $1\frac{3}{4}$ in. The oversize run as follows for the taper at the large end and for the straight portion: 2.067 in., $1\frac{29}{32}$ in., 2.129 in., $1\frac{31}{32}$ in., 2.192 in., $1\frac{7}{8}$ inch.

The holes for the taper pins in the ends are drilled and reamed after the pin has been fitted in place. The pin has two $\frac{1}{4}$-in. holes in the small end, $\frac{1}{2}$ in. from the center, for driving when finish grinding to size. The lengths of the various portions are, of course, standard for all pins of the same nominal size.

It is the plan to have bushings increase by $\frac{1}{16}$ in. in outside diameter. The bore is ground at the time of application to a running fit on its bolt. As a consequence there is usually a clearance of 0.008 in. for oil or grease.

Collar bushings, as for link-hanger brackets, are blanked out at the time of manufacture with an oversize outside diameter and with a flange $\frac{1}{8}$ in. thicker than the usual standard. The increased diameter makes it easy to fit reamed holes in brackets, and the thick flanges can be faced down so as to maintain the standard dimensions between flange faces when they are pressed into place in the brackets.

Two types of these bushings are employed. The type shown in Fig. 5 is for building up link trunnions to maintain the standard diameter; another type, not shown, is for bushing the link bracket to maintain the standard inside diameter to give the proper working clearance of 0.010 inch.

Three sizes of bushings are carried in stock, one for new locomotives and the other two for repairs, to take care of wear. Taking one of the larger sizes, to show how the dimensions vary, it is found that the diameter of the outside bearing is maintained at 2.994 in. with the three inside sizes 2.497, $2\frac{1}{4}$, and 2 in. The flange diameter, of course, remains constant.

The type of bushing used in the bracket, or part that receives the trunnion, is quite similar to the type illustrated in Fig. 5, but contains a straight oil groove and oil hole. The hole is kept standard, being 2.754 in. in diameter, which gives a working clearance of 0.010 in. in the bearing. The outside diameters are 3.256 in. for bushings for the new locomotives and $3\frac{7}{16}$ in. and $3\frac{3}{8}$ in. for oversizes, to be used in bushing holes in brackets or other supports. As with the other bushings, these are case hardened to a minimum depth of $\frac{1}{16}$ in. They are frequently ground after being forced into place, but in many cases they are ground and forced into the bracket without removing it from the locomotive. This practice is, perhaps, fairly indicative of the adoption of grinding as a standard machining process in the progressive railroad shop. It is of interest to note that common fractions are used in the majority of the dimensions given.

In the shops of one of the smaller railroads, little grinding is done. Valve motion bushings and pins are case hardened but are frequently run together just as they come from the quenching bath. In some cases the pins are ground in a lathe fitted with a toolpost grinder. No standard oversizes are used in this shop, both pins and bushings being finished to the original size on the bearing surfaces. The parts that fit worn holes are made to suit the smallest bores that will clean up the holes.

One railroad shop at least, and not a small one, uses brass bushings in the valve motion pin bearings. These bushings are of cast metal and are first bored and then

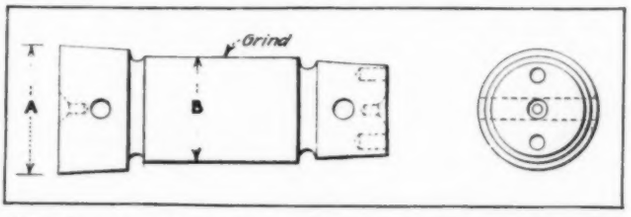


Fig. 4—Link block pin similar to the other pin but it is held by taper pins in each end instead of a screw and nut on the end. The ends are left soft so they can be drilled for the taper pins

turned on a mandrel. They are made to standard sizes only and new pins are turned to suit the standard holes.

The bearing pins are of soft steel and it is stated that this combination of metals wears well enough to last between shoppings of the locomotive. Because they do not cause locomotive delays during the interim it is considered good practice on this road. Grinding is not used in this shop to any great extent.

Another large railroad shop specifies that bushings must be turned on the outside for a press fit into motion parts, so that the pressure required will be between 2 and 3 tons per inch of outside diameter.

Bushings must have a close fit on the pins after application and must be bored and lapped or ground with a

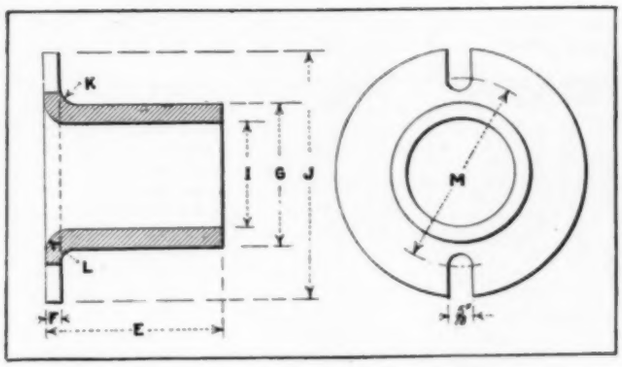


Fig. 5—Bushing for building up link trunnions to maintain standard diameter. Three sizes are carried in stock, one for new locomotives and the other two to take care of different amounts of wear

working allowance over the size of the pin as follows: Up to 1 in., 0.005 in.: 1 to 2 in., 0.010 in.; 2 to 3 in., 0.015 in.; over 3 in., 0.020 inch.

Motion parts must be reamed or ground to obtain round and parallel holes before bushings are applied. The limit for reaming is $\frac{1}{8}$ in. above original diameter, after which the hole must be built up by electrical welding and rebored.

Limit for wear for motion pins is 0.020 in. on wearing parts less in diameter than the original size.

Draftsman's Error Contest—*Discussion*

By W. R. Needham

LET me add a word to Mr. Kahn's outline of a means to reduce errors in bills of materials as published on page 534, Vol. 69, of the *American Machinist*. I am writing from the British or European standpoint.

The draftsman who considers a material list as a subsidiary or unimportant part of his drawing has yet to learn the very alphabet of his craft. Indeed, he has no right to be styled a draftsman, no matter how long a period he may have spent "at the board." Really, it should not be necessary to post a delinquent list any more than it should be necessary to bring responsible men to book for incorrect projection or faulty dimensioning. The material list is an elemental part of any design.

Most of the British and European draftsmen accept the detailing of the material as being of like importance with all or any part of the drawing. They make mistakes as do the draftsmen overseas, but they certainly regard those mistakes which concern the listing of material as being quite as culpable as any that appear. In fact, many a man would rather a mistake occur anywhere than in his material list. A mistake there is often the most serious mistake he can make. All draftsmen should know this. It belongs to the A.B.C. of their "must nots."

Inspection Methods and Their Application—*Erratum*

THE captions on Fig. 160 and 161, page 775, Vol. 69, of the *American Machinist*, were inadvertently transposed, the former showing the Lees-Bradner gear testing machine and the latter that built by the Pratt & Whitney Company. In Fig. 163 and 164, page 807, is shown a Rockwell hardness tester and not a Brinell, as stated.

SEEN · AND · HEARD

By John R. Godfrey

Lubrication again—Planers, presses and locomotives

IF ANYONE doubts that lubrication is receiving attention these days let him look at the modern planer at work, and compare it with the days when the squirt can was the only oiling system, which worked when the operator thought of it and the can did not happen to be empty. In the modern planer we see a fresh shot of oil on the ways every time the planer table starts on its return stroke, and see it spread itself over the ways ready for the next passage of the table. Even the balmiest days of the oil-can in the hands of the best operators never saw a job so thoroughly done.

Down inside of the bed we know the gears are running in oil, which also gets to every bearing. Contrast this with the old days when the gears were open to the world, which included chips in some cases, and when the bearings only got a few drops of oil when the planer hand, or his helper, thought of it. And we are still thinking of lubrication.

* * * *

One of the most striking examples of modern lubrication was a huge forming press with over 200 bearings. Imagine the job of oiling or greasing such a machine, especially with the bearings high up in the frame and slides of the machine. This particular machine had over a mile of piping to reach all the bearings.

Likewise consider the danger of oiling or greasing such a machine, with the ever present possibility that someone may, unintentionally, of course, start it in motion with an oiler somewhere in the upper rigging. The cost of having the machine idle long enough to oil it would make quite a start toward paying for an oiling system. And the cost of replacing a few bearings because the oiler overlooked an obscure oil hole, makes any positive system an economy.

* * * *

Jumping to an entirely different field, the locomotive this time, and we also find that thought of lubrication is uppermost in the minds of many. Different railroads are trying various methods of getting lubricant to such bearings as valve-motion pins, cross-head grinders, and the like. Some are providing small oil reservoirs as part of the casting or forging. Others are using large cups with nick feed, or with a spring-actuated plunger when grease is used.

But most striking of all, I have seen several locomotives almost completely equipped with special connections for a pressure grease gun, even to driving boxes and spring hangers. And best of all, tests seem to show that it pays.

Two engines were shopped recently that had both run about the same mileage. A number of bearings, such as the spring hanger pins, were O.K. on the lubricated engine, but had to be renewed, on account of wear, on the one where an occasional oil-canning passed for lubrication. Lubricant between rubbing surfaces is worth a lot more than it costs to get it there, and petty economies in the use of lubricant are often very expensive.

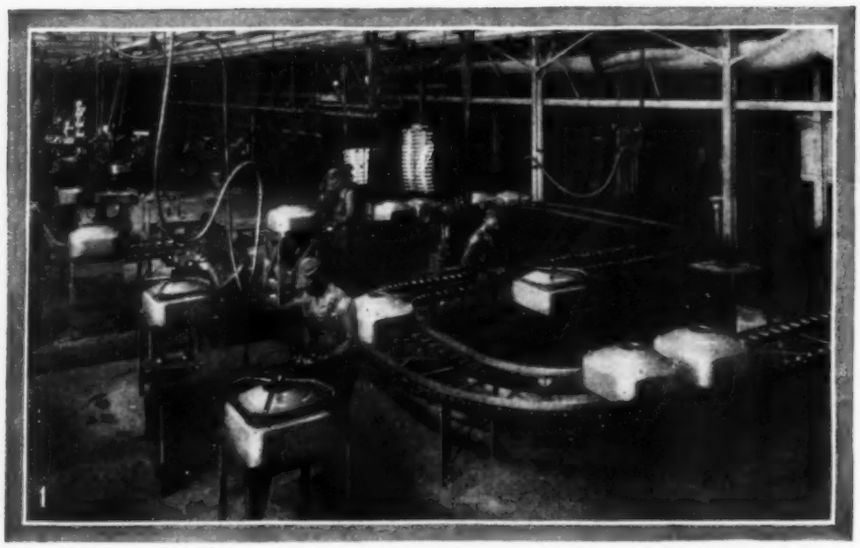


Fig. 1 — Arranging a gravity-type roller conveyor to cover an irregular course, has enabled final machining and fitting operations on washing-machine tubs to be handled in a limited length of floor space. The S-shaped layout not only conserves space but also makes possible the handling of a bulky product without congestion

Using Roller Conveyors to Serve Machines

Photographs by courtesy of the Standard Conveyor Company

Fig. 2—In handling heavy parts between operations, short sections of roller conveyors aid in transporting such work with a minimum of labor. Efficient handling of large and heavy parts in manufacture is as important as the tool equipment

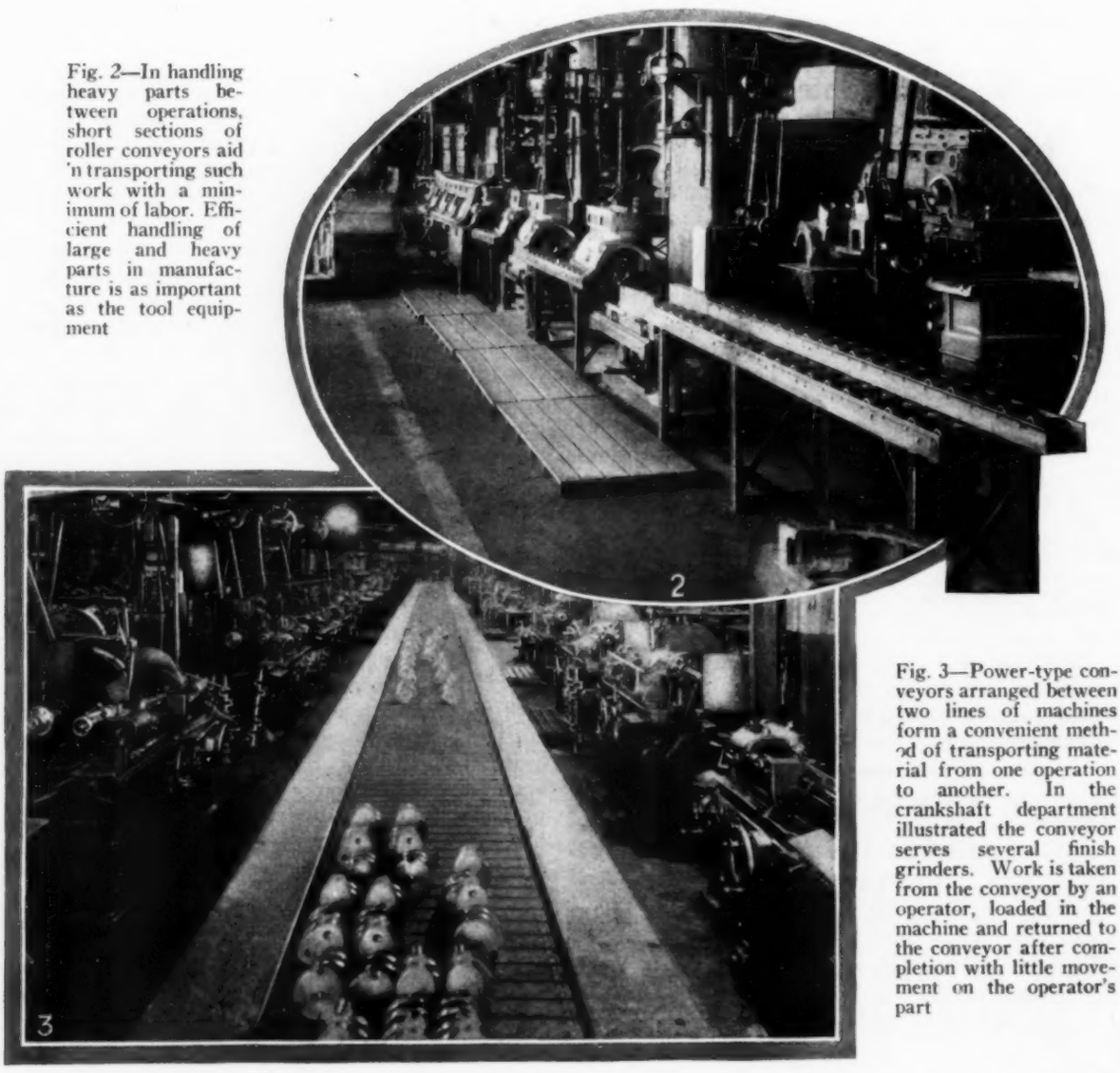


Fig. 3—Power-type conveyors arranged between two lines of machines form a convenient method of transporting material from one operation to another. In the crankshaft department illustrated the conveyor serves several finish grinders. Work is taken from the conveyor by an operator, loaded in the machine and returned to the conveyor after completion with little movement on the operator's part

Fig. 4—A gravity conveyor arranged to handle finished motors between the paint shop and the shipping department. After final inspection, the motors proceed on a conveyor to the far side of the department, where several painting booths are located. After being painted, the motors travel on a power conveyor through baking ovens, finally passing on to the gravity roller conveyor shown in the foreground

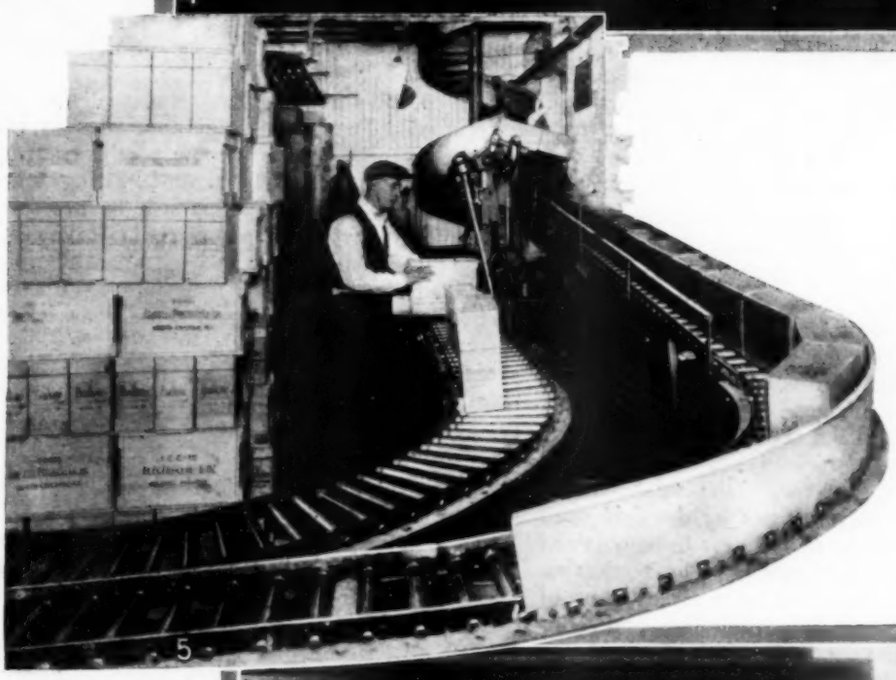


Fig. 5 — Finished products are advantageously handled by various types of conveyors, depending, of course, upon the nature of the part or its shape. Cartons, crates and boxes are usually transported on roller conveyors, excepting where inclines are required, in which case a power section is used. Spiral conveyors are also useful in handling products between floors, thus eliminating the use of elevators

Fig. 6—Transporting crated washing machines from the shipping department to the freight cars. After final tests and inspection, the washers are transferred to the shipping department where crating is handled as the work proceeds along a roller conveyor. Cut lumber is piled at convenient locations, enabling the crates to be assembled in a progressive manner

Mechanical Engineers Discuss

Management and Machine Design

Abstracts of Some of the Technical Papers Presented at the Annual Meeting of the A.S.M.E., December 3-7, in New York

The Executive Function in Industry

By Robert T. Kent
Manager, Engineering and Sales, Divine Brothers Company

ALL executive functions in an industrial plant fall under the general heads of finance, purchase, production, and sales. These divisions hold true whether the plant be large or small. Depending on the size of the plants they may be discharged by a single individual, or by a number of individuals, each with specialized duties.

For the purposes of this paper we shall consider each of the four functions as under the jurisdiction of a separate executive. Each executive has under him the necessary organization to carry out the functions of his department. The activities of all are supervised, controlled, and co-ordinated by a chief executive or general manager.

The most important tool with which the general manager can be supplied is the budget. It is by means of the budget that he co-ordinates the activities of the department heads.

Budget control should start with the sales budget. This is first made up from estimates by the field sales forces of the probable volume of business to be obtained over the budget period in the respective sales territories. The estimates should be expressed in terms of units of the company's products, rather than in dollars and cents.

The sales budget forms the basis of the factory production budget or schedule. The production schedule, in turn, is the basis of the purchase schedule. The production schedule, like the sales budget, should be expressed in terms of units of the company's product. The value of expressing the sales budget in periods of production is realized when it is translated into the manufacturing schedule.

Machine—Labor Factor

The manufacture of any given quantity of a commodity is controlled by two things, the machine capacity of the factory and the supply of labor available. There is, then, a certain number of machine-hours available in each production period. Each unit of the product requires a definitely predetermined number of these hours. The quotient of these hours divided into the total hours available gives the total number of units of product that can be made in any given period.

The production schedule eventually will be broken down into material requirements and labor hours necessary in each production period. Material requirements include the raw material and purchased parts that enter into the final product, also all supplies necessary to the operation of the plant.

The production schedule gives the purchasing executive information as to when he must make provision of adequate quantities of raw material and parts, together with the necessary supplies and fuel. Armed with the knowledge of what will be required in the line of material, and of the time at which it will be required, he then can plan his purchases so as to take advantage of market prices and effect substantial economies for his company.

All of the foregoing leads eventually to the financial executive. The sales budget indicates to the financial executive the probable income of the company in each production period. The manufacturing schedule indicates to him the money that will be necessary to meet payrolls at any given pay period. Likewise, the purchase budget shows him in what quantity funds must be provided to pay for raw materials. With these figures it becomes a simple matter for the financial executive to ascertain at what periods he will have a surplus of funds, and at what periods it will be necessary for him to arrange for funds.

The budget is more than a financial statement. It is a working tool for the chief executive. The budget is to an industry as a whole what production control is to the factory.

A Basis for Evaluating Manufacturing Operation

By L. P. Alford
Vice-President
The Ronald Press Company

and J. E. Hannum
Editor
The Engineering Index Service

WITH very few exceptions the factors that have been proposed and used to evaluate and compare the results of the operations of manufacturing companies are simple ratios or percentages.

At the outset of the study which has yielded this paper, the authors reached the conclusion that a group of compound units or factors built up from a common base would be more useful than any group of simple ratios or percentages. One thousand man-hours, conveniently named the "kilo man-hour" has been taken as this unit. From this base factor numerous factors of industrial operation can be developed.

A considerable volume of records, statistics, and data on manufacturing operations was available to the authors for study and analysis in preparing this paper. The Safety and Production Report of the American Engineering Council, published early this year, gives a large number of production rates per man-hour expressed in physical units. These factors are for the year 1925. The published reports of the United States Bureau of the Census and of the United States Bureau of Mines for the year 1925, taken together, give statistics for the number of employees, physical production, wages, cost

of materials, value added by manufacture, and the value of products for the manufacturing and mining industries. These reports from the principal source of information used in this study.

From the nature and origin of the data, and the methods of classification employed, the authors attach but little significance to the actual numerical values given. The important features rather seem to be the relationships and relative positions in sequence of the various factors and industrial groups with which they are associated.

In the comparisons between industries the production rates are possibly of more interest than significance. Yet a few relationships may properly be pointed out. The production rate for boilers and tanks is 12.05 tons, for agricultural implements 16.65 tons, and for sheet-metal products 17.30 tons. The last rate is the highest for the machinery-building and metal-working groups. The lowest rate among these groups is for machine tools, 2.70 tons, and this is less than one-half that for special machinery, which is 5.15 tons. Another low production rate is that of engines, turbines, and pumps, 3.17 tons.

The comparisons of values per thousand factory man-hours are worthy of more extended consideration.

Large Spread in Selling Values

The spread of selling values, measured in dollars per thousand factory man-hours worked, ranges in round figures from $550 to $10,800, or in the ratio of 1 to 19. Industries which during the past few years have been prosperous are near the top of this list; and others which have become notorious because of their business troubles are near the bottom.

Seemingly a high selling value of product per thousand factory man-hours worked indicates prosperity, and a low value for this same factor tends toward business distress. This indication is supported by a consideration of net profit on this same basis.

One more inter-industry relationship requires consideration: the relation between managerial effort and selling value of product. It may be assumed as substantially true that managerial effort and supervisory costs of man management vary directly with the number of man-hours worked. This being so, it appears that the managements of some industries exert far more effort in man supervision for, say $1,000 worth of product, than others. For example, this managerial ratio for writing paper and rubber tires is 5 to 1; for leather shoes and lead products, 5½ to 1; for gray-iron castings and automobiles, 6 to 1; for candy and soap, 6½ to 1; for cotton fabrics and paint, 7 to 1; and for machine tools and flour, 7 to 1.

That variations exist between the effectiveness of operation of plants in the same industry is well known. The extent of such variations measured in physical output per thousand man-hours, as indicated by this study, show that many plants in every line of industry need upgrading to bring their production per man-hour up to the high level already attained in that industry.

Much discussion has been given to the question of relative efficiencies of large and small plants. Data on this point for 53 product groups give indications in favor of the small plant when measured by the number of workers employed. This high production per hour, which must be accompanied by low manufacturing cost, may be a reason for the persistence of the small plant in spite of consolidations and mergers. A survey made by the Chamber of Commerce of the United States for the year 1927 shows that of 1,701 newly located plants, 1,537, or 90 per cent, employed fewer than 100 men.

An analysis of the data follows:

The smallest company has a higher rate of production than the largest company in 35 industries.

The smallest company has a lower rate of production than the largest company in 18 industries.

The smallest company has the highest rate of production in 16 industries and a high rate in 5 industries.

The smallest company has the lowest rate of production in 6 industries and a low rate in 16 industries.

The largest company has the highest rate of production in 3 industries and a high rate in 8 industries.

The largest company has the lowest rate of production in 18 industries and a low rate in 10 industries.

The smallest company has the highest rate of production and the largest company has the lowest rate in 8 industries.

The principal implications of the comparisons presented, wherein certain plants and certain industries are shown to have high values for production, value added by manufacture, selling value of product, wages paid, and net profit earned, all on the basis of one thousand factory man-hours worked, and certain other plants and certain other industries have low values for all these factors, are two:

That American industry may continue to progress,

1. Those plants having low operating factors, as shown by the man-hour basis, must be upgraded until their records are substantially equal to the average of their product group.
2. Those industries that have the lowest factors must be upgraded until they substantially equal in performance other industries that are making a satisfactory manufacturing profit.

The most potent attacks that can be brought to bear upon this problem of upgrading are in the reduction of waste, lowering of cost, and improvement of processes, equipment, and methods.

Outstanding Factors in the Engineering of New Manufacturing Equipment

By J. R. Shea

Superintendent of Manufacturing Development
Western Electric Company, Incorporated

ONE of the most important problems of modern industrial management is that of selecting or developing suitable manufacturing equipment. This question is constantly before every progressive manufacturer in his effort to reduce costs, and it becomes more pressing whenever additional plant capacity is required to provide for an increase in the volume of business, a change in the design of the finished product, or the introduction of an improved manufacturing process. Good management demands that in every case the necessary equipment shall be secured on the basis of its ability to produce the finished article to the desired accuracy and at a minimum cost. Moreover, each machine selected should be of a type such that it will fit into an ultimate plan for the entire plant, so that it may function as a part of a single economic unit.

Improved machine equipment should be selected or developed not only from the standpoint of its unit production, but also with regard to the ease with which material may be moved to it and taken away, as by giving proper

consideration to this point it is possible to minimize the investment in material in transit throughout the factory. The amount of material required to operate a plant is affected not alone by the machine equipment, but also by its arrangement and by the means provided for handling the material in process.

A comprehensive analysis of the technical phase of each problem should include a study of the design of the product, of processes for its manufacture, of the machine equipment, and of the factory arrangement. However, in many cases some outstanding development in methods of processing may dominate the entire situation, including both the design of the product and the equipment required for its manufacture.

The analysis of the product should cover items such as quantity to be manufactured, the status of the development of the design, its permanency, the question of the choice of materials, and the degree of manufacturing excellence required. The magnitude of the requirements for any given article will determine to some extent the type of equipment which may be best suited for its manufacture. It is very often necessary to modify the design of an article in order to take advantage of the manufacturing economies which such a change would make possible.

Changes in Material Often Desirable

It is often likewise desirable from a technical standpoint to change the material of which an article is made—for example, to substitute welded steel for cast iron—and such a modification is usually accompanied by a corresponding change in the type of equipment required. Thus, in the present instance, welding equipment would replace foundry equipment.

Apart from the question of the design of the product, the processes selected for its manufacture will have a greater effect than any other single factor upon the selection of equipment, the quality of the product, and its final cost.

The process should be chosen only after thorough consideration has been given to the status of the development of the manufacturing arts involved, the trend in the cost of materials, and the degree to which the process may be accurately controlled.

It would seem useless to expend a considerable amount of money in the investigation of the most desirable processes if equipment were not also chosen on the same basis. The former practice was to make the process fit the available equipment, a procedure which often resulted in entirely overlooking the most economical method. The modern tendency, however, is to decide upon the best method from the standpoint of economy and quality, and then to select or develop equipment to fulfill these new requirements.

Process control is an important item, as the trend in most lines of industry is toward more exact methods in order to cut down waste and to obtain a better product. As a result of this trend, equipment which was once regarded as satisfactory is being replaced by newer and more suitable machines.

When the design of the product has been decided upon, the quantity requirements determined, and the best available process selected, it will be found that the most suitable manufacturing equipment may be chosen from a comparatively narrow field. The choice will then rest between types of machines. The equipment selected, whether a simple hand-operated tool or fixture, a standard general-purpose machine tool, or a special-purpose machine, must be capable of meeting the standards of accuracy and quality required in the finished product, and it must be designed and constructed so that it will reduce each item of cost to a minimum consistent with the total investment required.

The final step in the engineering of the plant, that of deciding upon a suitable arrangement of machines, is one of the most vital factors entering into the problem. At times this question is of major importance, often deciding the selection of one type of equipment in preference to another.

The goal of every machine arrangement layout should be to keep manual handling and labor cost at a minimum, to eliminate idle equipment, and to make it possible to operate the plant with a minimum investment.

Manufacturing concerns producing a large variety of products find it advantageous to arrange machines in groups according to their type. In plants of sufficient size, this departmentalized grouping of machines may be carried even further and each type of equipment subdivided according to size or according to the character of operations performed. The more important arguments in favor of departmental grouping of equipment are more intensive utilization of the available equipment and the fact that small lots of work can be handled nearly as economically as larger lots. The departmental grouping of equipment has the disadvantage of requiring more handling, more inspection, more supervision, more investment in the materials being processed, and generally more clerical work. However, even in factories producing a large number of products it is often found desirable to set up straight-line arrangements of machinery for the manufacture of products for which there is a high annual demand or for those operations which can be performed more economically with this arrangement.

In conclusion it may be stated that the selection or development of manufacturing equipment is an engineering problem which should be solved on the basis of a sound economic and technical investigation.

Discoveries and developments of a purely scientific nature which a generation ago required a number of years for their application now find their way into practical use within a relatively short period, and the manufacturer and the engineer must fully appreciate the significance of such developments and so arrange their plans that changes can be readily made.

Fatigue and Corrosion-Fatigue of Spring Material

By D. J. McAdam, Jr.
Metallurgist, U. S. Naval Engineering Experiment Station

FATIGUE failure of metals is due to the repeated application of a range of stress that is insufficient to cause failure on single application. The range of stress may be between zero and a maximum, or between a maximum and minimum value, or there may be complete or incomplete reversal of stress per cycle. Fatigue depends more on the range of stress than on the extremes of the range. It has been definitely established that, below a limiting value of the stress range, fatigue failure does not occur even after many million applications of the stress range. This limiting range has been called the "endurance range." A greater range causes failure after a number of cycles that decreases rapidly with increase in the range. When the endurance range involves complete reversal of stress per cycle, as in a rotating

beam or cantilever, the half range is known as the "endurance limit" or "fatigue limit." The object of the great majority of endurance tests of metals has been to determine the "endurance limit."

The endurance limit seems to be more closely related to the tensile strength than to any other physical property except the Brinell number. The endurance limit seems to have very little relationship to elastic limit or to ductility. The ratio of the endurance limit (as obtained by rotating beam or cantilever) to the tensile strength, which has been called the endurance ratio, is for most normal metals between 0.4 and 0.55. For some non-ferrous metals the endurance ratio is lower, and may be as low as 0.25.

For spring steels the ratio of the endurance limit in tension-compression or repeated bend to the tensile strength is from 0.4 to 0.5. The ratio of the torsional endurance limit to the tensile strength is from about 0.2 to 0.3. The torsional endurance range is about twice the torsional endurance limit and is practically constant for any position within the elastic range. It seems possible, also, that in tension-compression or repeated bend the endurance range is practically constant within the primitive elastic range.

Consideration of Spring Materials

Monel metal and other nickel-copper alloys can be obtained, by cold-working, with tension-compression endurance limit greater than 50,000 lb. per sq.in., and with torsional endurance limit of about 35,000 lb. per sq. inch.

For copper-tin alloys the 5 per cent alloy, known as phosphor bronze, can be obtained with tension-compression endurance limit of about 27,000 lb. per sq.in. in the form of 1-in. round bars. In the form of smaller rod or wire, the endurance limit may be somewhat higher. Cold working, however, does not raise the endurance limit of this material in proportion to the increase in tensile strength.

The above-mentioned endurance limits are obtained with smooth specimens. The fatigue limit is greatly influenced by surface defects. Even shallow defects, if sufficiently sharp, may practically neutralize the effect of high strength on the fatigue limit.

Spring steels subjected to a range of stress while in contact with fresh water fail at a stress range only one-fourth to one-ninth the ordinary endurance limit. In contact with salt water the endurance range is even smaller. Under such conditions the advantage of high strength due to composition or heat-treatment is lost. The corrosion-fatigue limit depends more on electrochemical than on physical properties.

The corrosion-fatigue limit of corrosion-resistant steels is about twice that of ordinary steels. Corrosion-resistant steels are available with elastic limit high enough to be suitable for spring material. Electroplating ordinary steels with cadmium and probably with other metals more than doubles the corrosion-fatigue limit.

Heavy-Duty Anti-Friction Bearings

By Sidney G. Koon
Associate Editor, The Iron Age

BENEFITS to be expected from the use of roller bearings in mills are fourfold. They may be classified as (1) power savings; (2) reduction in maintenance; (3) practical elimination of repair costs; and (4) continuity of operation of the mills.

Many formulas have been developed by manufacturers engaged in designing and producing roller bearings for various purposes. Other formulas have been developed by theorists in dealing with the forces involved. Any ball or roller bearing can carry a greater load than the theoretical formula provides.

Due to the great strength of the specially hardened steels used for anti-friction bearings, with their elastic limit as high as 300,000 or 400,000 lb. per sq.in., a very great specific load can be carried by such bearings. This goes beyond anything possible in a plain bearing depending upon brass or babbitt.

High speed introduces serious complications in roller bearings as well as in other types. Small thrust bearings made some years ago for a machine which was to operate at 3,600 r.p.m., and which were made at a tolerance of only 0.0001 in., gave a peculiar sort of musical note when up to speed. It happened that the rotative speed of the machine corresponded with the natural harmonic-vibration cycle of the bearing, with the result that at that exact speed the sound was caused.

Simplicity and massiveness are the most modern features of machinery design. They are characteristic of all that is best practice, both being required for heavy loads and for high speeds.

Some of the most trivial matters from the design standpoint must receive careful attention if an anti-friction bearing is to be successful.

Three essentials characterize the building of roller bearings today: The first is steel of proper composition and properly manufactured for both rollers and races. The second is accurate temperature in the heat treatment of the finished parts, which customarily must be kept within the plus or minus 8 deg. of the specified temperature, and should be kept within 3 deg. The third is the extreme precision of the final finishing on the grinding machine.

Ordnance Applications

Anti-friction bearings have been introduced widely into the mechanism of gun carriages. The lower pintle thrust bearing for the United States 14-in. railroad mount—by far the most powerful gun used by either side on any front during the World War—has 34 balls 4 in. in diam. in hardened steel races having a diameter of 51¾ in. at the center of the balls. The traveling weight of this mount is 730,000 pounds.

Perhaps the most severe stresses to which roller bearings have been subjected in ordnance design are those in the trunnions of cradles in which the gun slides in recoiling. Anti-friction bearings in these trunnions have been applied for heavy duty in gun carriages for guns from 3 in. up to 16 in. bore. The object has been to accomplish elevation or depression of the gun's axis in the shortest possible time.

The problem of knowing accurately what loads anti-friction bearings must be prepared to take is of greater importance to the designer and the manufacturer of the bearings than is any question of power saving. Sixty-nine pressure tests made by one bearing maker indicate clearly that far greater loads are imposed upon roll necks than have been assumed on the basis of empirical determinations.

Loads which may safely be put on these roller bearings vary considerably with the conditions under which they are required to operate. It seems safe to assume that a roller bearing will carry at least 50 per cent more load than a ball bearing of similar dimensions. In spite of all load tables, however, the capacity of a bearing can-

not be definitely reduced to a formula, for no formula can take into account adequately the effect of varying conditions. Experience with plain bearings does not help, for the substitution of rolling for sliding friction changes the problem completely.

Failures of anti-friction bearings are due in 99 cases out of 100 to gross abuse. This is usually neglect, although it may involve a certain element of ignorance as well.

It has been the experience of those who have designed and installed numerous mills of the backed-up type in the past five years that trouble with backing-up rolls and their roller bearings is practically nil.

Power Consumption Tests

Comparative power-consumption tests on mills run alternately with anti-friction bearings and plain bearings have yielded valuable data. Variations in temperature of the steel being rolled have made the tests less directly comparable than might be wished, but the information available is being augmented from time to time by additional test data. The earliest, and possibly the most complete, of these tests were made on a three-high 16-in. bar mill in Canton, Ohio. Records of the rolling of 279 billets, in tests made two and a half years ago, showed average savings of about 48 per cent.

The application of roller bearings to the backed-up strip mill is still too close to the experimental stage to permit drawing any definite conclusions as to what its final form will be. In one case, where the finishing stands are run at very high speed, certain things have been observed which might not apply equally or at all to a backed-up cold-rolling mill or to a hot mill of lower speed.

Steel-mill engineers who have adopted roller bearings for rolls on backed-up mills, and who recognize their great utility for that purpose, do not favor their indiscriminate use elsewhere. As one such engineer puts it: "The present state of development in roller bearings for main mill rolls does not warrant our consideration of them except in cases beyond the limits of the two-high mill."

Wherever roller bearings have been installed on rolling mills, it is the general opinion that they have paid for themselves where they have operated successfully. Where they did not operate successfully, they created sufficient interest in their possibilities so that their application is being considered on new equipment so designed as to overcome space limitations and permit their satisfactory introduction.

Friction of Journal Bearings as Influenced by Clearance and Length

By S. A. McKee and T. R. McKee
Assistant Mechanical Engineer, Research Associate
Bureau of Standards

THE factors that determine the performance characteristics of journal bearings might conveniently be divided into two classes, operating factors and factors of construction. Among those classed as operating factors (i.e., those that are dependent upon the particular conditions of operation) are the load on the bearing, the speed of the journal, the temperature of operation, and the viscosity, oiliness, and amount of the lubricant. Among the factors of construction (i.e., those that are built into the bearing itself) are (1) the absolute size as represented by the journal diameter; (2) L/D, the ratio of the length of the bearing to the diameter of the journal; (3) C/D, the ratio of the diametral clearance to the diameter of the journal; (4) the condition of the bearing surfaces, which is dependent upon the materials of which the journal and bearing are made, their smoothness, and their deviation from true cylindrical form; and (5) the means for applying or retaining the lubricant, such as oil holes, oil grooves, and relieved spaces.

The object of this study is to determine the effects of changes in two of the most important factors of construction in a normal bearing—namely, the L/D and C/D ratios—in the hope that the results may be of value in the formulation of rational methods for bearing design.

The method chosen for showing the effect of changes in clearance and length was to measure the frictional resistence of a set of bearings having a given length and clearance under a wide range of operating conditions and to repeat the measurements with other sets of bearings having different lengths and clearances, the same journal being used in all the tests.

The particular choice of units and notation employed are the same as were used in previous investigations and consist in expressing the viscosity in centipoises, the speed in r.p.m., and the bearing pressure in lb. per sq.in., and in denoting the respective quantities by Z, N, and P when so expressed. The graphical method of this paper may therefore be very simply described as a comparison of the f–(ZN/P) curves for bearings of the same absolute size having widely different values of L/D and C/D.

Description of Apparatus

The machine used in these tests was originally designed to use four connecting rods of an automobile engine, with the babbitt-lined "big end" bearings serving as test bearings, mounted on a steel shaft set in a lathe. These rods were used in the tests where the L/D ratio was 1.00, but in all the others solid-bronze babbitt-lined bearings, clamped in special holders of the same general shape as the connecting rods, were used. These four rods are fastened to a frame by means of eyebolts and clevices in such a manner that they lie in a horizontal plane with the two end bearings on the opposite side of the shaft from the two in the middle. The frame is suspended by two equalizers mounted on a cross-beam fastened to the frame just above the shaft. Load is applied to the bearings by compressing the calibrated coil springs mounted on the sliding eyebolts fitted to the end rods.

Oil is fed to the center of the unloaded sides of the bearings by lines of rubber tubing from a glass bottle. The oil is forced from the bottle by the house air pressure of about 7 cm. of mercury.

The results at the higher values of ZN/P are so consistent that it appears worth while to represent them by a simple equation whereby the frictional torque of a given bearing may be estimated for most normal operating conditions.

The results indicate that for bearings having an L/D ratio of 1 or thereabouts, the Sommerfeld or Harrison equations will give results accurate enough for practical purposes where the value of ZN/P is greater than 100 and where the coefficient of friction is greater than 0.01. Thus the charts based upon Harrison's equation for bearings of various nominal C/D ratios in Howarth's graphical analysis are suitable for bearings of this type. These equations, however, do not take end effects into account and thus can be considered fair approximations only where L/D is greater than about 0.75.

In developing corrections for various L/R ratios

Petroff's equation, owing to its simplicity, appears to be most suitable to use as a basis. While this equation is based upon the assumption that the journal is at all times concentric with the bearing, the deviations between it and the more rigorous Sommerfeld or Harrison equations are negligible at values of ZN/P above 100 and values of f above 0.01.

This equation when expressed in the units employed in this paper becomes

$$f_P = 473\left(\frac{ZN}{P}\right)\left(\frac{D}{C}\right)10^{-10} \quad \ldots\ldots\ldots\ldots (1)$$

The equation chosen to correct for the L/D ratio is

$$f = f_P + \Delta f \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where f = coefficient of journal friction for an actual bearing

f_P = coefficient of friction as determined by Petroff's equation

Δf = L/D correction.

This assumes that all the experimental curves for a given L/D ratio are parallel to and equidistant from the Petroff curves for the same C/D ratios. This of course is not exact, but the values obtained are a fair approximation throughout the whole range covered.

The maximum error in using this method is about 16 per cent, the average being about 4 per cent. Thus the equation

$$f = 473\left(\frac{ZN}{P}\right)\left(\frac{D}{C}\right)10^{-10} + \Delta f \quad \ldots\ldots\ldots (3)$$

should be reasonably accurate for the practical determination of friction losses in small-bore full journal bearings provided ZN/P is greater than 100 and f greater than 0.01. It is of course understood that the speed and load are fairly constant and that an adequate supply of oil is maintained at a relatively low pressure, and that there are no oil grooves in such a location on the bearing surface as to materially affect the pressure distribution in the film.

The limit of the scope of this investigation is to provide a reasonably accurate experimental indication of the behavior of small-bore full-journal bearings of various clearances and lengths, under normal working conditions.

While the results of the tests at the higher values of ZN/P are fairly consistent with theoretical equations based upon the viscous shear of the lubricant, it would not be justifiable to predict that these results would be a reliable indication of the characteristics of large bearings operating at high speeds and high loads, since it is reasonable to expect that under the latter conditions the effects of such factors as journal deflection, distortion caused by uneven heating, and changes in viscosity due to temperature gradients in the oil film may be of considerable magnitude.

The inconsistencies shown by the results at the lower values of ZN/P are an indication that considerable caution should be used if the carrying capacity of a particular bearing is determined by any method based upon the theoretical value of the minimum thickness of the oil film.

Further steps toward a better understanding of the performance of full-journal bearings suggested by these tests are: (1) to make similar tests of the effect of changes of clearance and length using larger diameter bearings under heavier loads and at higher speeds, and (2) to determine the carrying capacity of bearings by a study of the effect of changes in bearing metal, lubricant, and over-all dimensions upon the point of minimum friction of bearings finished by the usual commercial methods.

Papers Relating to Woodworking Machinery Design

The Application of Universal Chucks to Woodworking Machinery

By A. E. Englund

Chief Engineer, Jacobs Manufacturing Company

FOR the purpose of this discussion, woodworking machinery will be divided into three classifications to conform to the varying means of holding tools or bits. These are boring and routing machines, lathes, and combination woodworking machines.

Borers and routers are to the woodworking industry what drilling and milling machines are to the metal-working field. Universal chucks are used almost exclusively on metal-working machinery, and they are equally adapted to the same use on similar-purpose machines in the woodworking field. By the use of these universal chucks it is possible to change boring bits instantly, no matter what the diameter of the shank may be, and be sure that the boring bit is held accurately in a central position.

Many boring machines in common use at the present time have a straight hole bored in the spindle. This hole is usually $\frac{1}{2}$ in. or $\frac{1}{4}\frac{1}{4}$ in. in diameter, and to fit tools to the spindle it is essential that they have shanks of the same diameter as the spindle in which they are held by means of a setscrew. This results in eccentricity, as the shank of the tool cannot be perfectly fitted in the bored hole, and the setscrew has a tendency to damage the shank and to force the tool to one side of the spindle. However, universal chucks may be permanently fitted to spindles of the setscrew type by means of an arbor, one end of which is machined straight and the other tapered to fit the tapered hole in the chuck. In mounting a chuck and arbor in this manner it may be difficult to eliminate eccentricity completely, but it stands to reason that a higher degree of accuracy can be secured on a permanent fitting of this character than where tools with scored shanks are being constantly changed.

A few borer and router spindles are produced with taper holes, and, as in metal-working practice, taper arbors accurately fit chucks to these spindles and represent the ideal spindle construction.

Routing machines of the stationary type have in the past been furnished with straight-hole spindles, similar to older boring-machine practice. Routing tools are fitted to these by means of the setscrews and universal chucks may be fitted by means of straight arbors.

Routers of the portable type present a new problem in tool holding on account of their high speed and sensi-

tivity. These portable routers are a development of recent years, and in almost every instance a universal chuck has been fitted directly to the spindle. It can readily be seen that, if the tool bit is not held in a central position, the spindle will not be balanced and excessive vibration and wear will result.

A universal chuck may be listed as very essential equipment on a woodworking lathe, and is used to great advantage in both the headstock and tailstock. Any symmetrical piece within the capacity of the chuck may be held in the headstock, while machining operations such as boring, drilling, or countersinking can be quickly and accurately done by means of tools held in the tailstock. This application enables the operator to change tools, bits, or the work itself in minimum time. Nearly all woodworking lathes are provided with Morse-taper spindles, and it is a simple matter to fit chucks to these by means of Morse-taper arbors.

The combination woodworking machine is also a development of recent years, and introduces into building construction machine-tool methods similar to those developed in the production woodworking field. In nearly every instance, universal chucks are standard equipment and are mounted on the boring spindle by means of tapers or threads.

Ball Bearings as Applied to Woodworking Machinery

By H. E. Brunner
Chief Engineer, SKF Industries, Inc.

ANTI-FRICTION bearings of the ball and roller types are extensively used in almost all classes of woodworking and saw-mill machinery. The ball bearing is employed to meet those conditions where high speeds and moderate loads prevail, while the roller bearing is used where lower speeds and relatively heavy loads exist. Both types have successfully met the exacting requirements imposed upon them.

The plain bearing, being dependent upon an oil film to operate successfully, is particularly susceptible to bearing failure. Such failures are costly as they result in loss of production and possible damage to the machine.

Woodworking machines are operated where considerable inflammable waste material is present and when failure occurs there is a possibility that this material will be ignited. This fire hazard is eliminated by the antifriction bearing.

All plain bearings are susceptible to appreciable wear, and this becomes a serious objection in woodworking machinery since it allows heavy vibrations, resulting in subsequent bearing failures, and the quality of finish is seriously affected.

The trend of the whole woodworking industry has been toward higher speed for improved quality of finish and increased production. Many of the speeds encountered are well beyond the economic limits of plain bearings and the accuracy required precludes their use.

For the purposes of discussion, applications will be divided into three groups:

1. Heavy-duty saw-mill machinery.
2. Low-speed woodworking machines, non-precision type.
3. High-speed woodworking machines, precision type.

The roller bearing is well suited to the first class of service since it is capable of carrying heavy shock loads without failure. There is also a considerable saving in lubricant and maintenance costs since these bearings need only be lubricated periodically and the bearing housings can be made to provide effectively against leakage or loss of lubricant. Since no wear occurs in properly designed roller bearings when they are well mounted and protected against dirt intrusion, the rotating parts are always in proper adjustment. Vibration is likewise avoided so that the quality of finish is well maintained. A considerable saving from a power standpoint can also be realized on these heavy applications.

The second class includes such machines as saw tables, band saws, swing saws, circular saws, sanders, gear drives, feed-roll mechanisms, and others operating at moderate speeds under relatively light loads which can be very well met by the use of standard ball bearings. The advantages gained by the use of ball bearings are very similar to those outlined under "Saw-Mill Machinery," not the least of which are the better quality of finish due to the avoidance of vibration.

In the third class are to be found shapers, surfacers, jointers or buzz planers, mortisers, borers and tenoners, molders, planers, matchers and lathes. Speeds ranging from 3,600 to 8,000 r.p.m. are commonplace. The demand for these high speeds has been brought about by the necessity for increased production so as to meet the requirements of plants engaging in furniture making, automobile-body building and radio-cabinet making. The use of properly designed ball bearings has in no small degree helped to solve many of the difficult problems which presented themselves to the machine manufacturer.

It was found in the early work of applying ball bearings to these high-speed machines that they were not satisfactory. The most difficult problem was to build machines having accuracy and freedom from vibration, and to attain this end it was necessary to give special attention to the design of the bearings and mountings particularly as to accuracy.

It has been found that, in order to fit the bearing on the shaft and in the housing properly, the shaft and housing seats must be ground to a smooth finish and held within tolerances comparable with those required for the bore and outside diameter of the bearing.

Lubrication of Ball-Bearing Woodworking Spindles

By Harry R. Reynolds
Chief Engineer, The Fafnir Bearing Company

THE purpose of this paper is to bring out methods of lubrication especially suitable for speeds of 4,000 to 7,500 r.p.m., which is about the range of present-day woodworking spindles.

The oil or grease must be neutral, as any acidity would etch and ruin both balls and raceways. This immediately eliminates the animal and vegetable oils and greases as they develop acidity with age. Neither should solids such as graphite, talc, and pumice be used as they fill up the raceways and are one cause of rupture of both rings and races.

Any system of oil lubrication where the oil is either circulated or frequently renewed tends to keep the bearings constantly flushed out, and a ball bearing kept free from dirt is a long-lived bearing. The disadvantages of oil are due mostly to the fact that it is difficult to keep it in the housing. Any housing design which has an oil level high enough to allow the balls to rotate in the oil

permits churning to take place. This causes heat, which thins the oil still further. The resultant vapors follow the air currents and work out of the housing, this constant leakage requiring that the oil be frequently renewed. To prevent this leakage and to feed oil to the bearings without their being submerged in it, requires a complication of parts which are costly. A further disadvantage of oil is that, except when running, the bearings dry off and are then exposed to rust.

All grease is not suitable. A grease is not necessarily good because it has a nice color, feels slippery, and has a pleasant odor. There are many greases which after standing tend to harden. When others are exposed to heat sufficient to melt them the oil works out and leaves the filler, which generally dries down like so much shellac. It is even more important that the proper grease be used than the proper oil. Fortunately, there are many satisfactory greases which can be used for lubrication.

The greatest disadvantage of grease is that dirt and grit mix with it, which converts the grease into a lapping agent. It does not flush out the bearing as will oil. Therefore, if dirt gets into grease, more rapid wear will surely follow:

If balls and raceways break down, it is due to either overload or cramp. If cramp, the ball track on the raceways will not run true but will stagger from side to side. If the bearing is badly loosened and wabbly, this is because dirt has got in and lapped down the balls and races.

At 5,000 to 5,700 r.p.m. a very light spindle oil should be used and should be fed either by wick or circulation from pump. Too much should not be used as it will cause heating; and the higher the speed, the greater the heat.

With grease, if the proper consistency is used the housing can be filled. At high speed there will be a path cut through the grease by the balls, and if the temperature rises, just enough melting will occur to furnish the lubrication required.

Greases soft enough to churn should be avoided for high-speed applications as the heat generated will melt them so fast that they will be as objectionable as too much oil.

Failure is generally due to dirt, so bearings should be kept clean. Special care should be exercised when renewing the lubricant as it is at this time when most of the dirt gets in.

Cooling and Lubrication of Cutting Tools

Progress Report No. 1 of the Sub-Committee on Cutting Fluids of the A.S.M.E. Special Research Committee on Cutting of Metals

THE superiority of lard oil for such processes as heavy-duty cutting of steel may in all probability be attributed to its function as a lubricant, and especially to its action in lubricating the top surface of the tool directly under the chip. Journal bearings, if subjected to the same exceptionally heavy pressures encountered by cutting tools, would undoubtedly run cooler with lard oil than with mineral oil. When the journal is lightly loaded, however, lard oil offers greater frictional resistance than a mineral oil having the same viscosity at room temperature because it does not thin out so rapidly with rising temperature, it still remains too viscous after the maximum operating temperature has been reached, and the bearing runs hot in consequence of greater frictional resistance, due to excessive viscosity. Lard oil is also inferior to mineral oils for long-continued operation of journal bearings, due to its rapid oxidation with consequent gumming and corrosion effects which tend to further increase the friction.

The superiority of lard and other fatty oils in contrast with mineral oils under high contact pressures is a recognized lubrication phenomenon commonly described by saying that the fatty oils possess the property of "oiliness" in a marked degree.

Microscope observations of chip formation conducted by Albert Kingsbury about 1895, showed that when a mild-steel bar is cut by a parting tool in a lathe, a crack in the metal precedes the cutting edge of the tool at all times. As the crack extends, the oil is seen to flow into the crack, the flow being made evident by the motion of minute particles of steel suspended in the oil. Thus the oil is enabled to reach the top surface of the tool, even to the cutting edge. The lubricant is forced into the vacuum in the crack mainly by atmospheric pressure, capillarity probably being secondary if the cutting speed is high. Therefore, if the viscosity of the lubricant is too high, the cracks may not be filled fast enough.

The addition of tallow or any other animal fat to a mineral oil is known to increase its oiliness.

When drilling glass and very hard steel it may be more important for the cutting edge to bite than it is to provide a high degree of lubrication; possibly such fluids as kerosene, turpentine, and alcohol function by increasing the coefficient of friction of the rubbing surfaces over and above the value it would have for dry surfaces. If so, these liquids might be classed as negative lubricants, and the concept of the lubrication of cutting tools might be extended to include both positive and negative lubrication.

Further, it has been suggested that the turpentine and other thin liquids may provide a means for the drill to get below a layer of powder formed by the drilling action, where, if used dry, the cutting edge would roll around on these particles which would act like ball bearings, thus preventing the edge from biting into the uncut surfaces of the glass.

Sulphur is believed to increase the oiliness of lubricating oils, which, if so, would diminish the friction and therefore the amount of heat released in cutting metal. These facts might be sufficient to account for the superior cutting performance of oils containing sulphur without recourse to its alleged refrigerating effect, but should be tested by quantitative experiments.

While water cannot function as a lubricant under the pressures commonly met in a machine bearing or in cutting of metals, it has been demonstrated that it does act as a lubricant when the pressures are low enough to permit the formation of a true fluid film. It is believed that the water adheres to the knife, in one example which was brought to the attention of the committee, and reduces the resistance offered to the movement of the blade through the soft rubber which was being cut.

One important function of the lubricant under the chip on the top of the tool, quite independent of its

function in reducing the heat generated and in reducing the power consumption, is to insure a steady, uniform back pressure against the chip, thus tending to produce a more uniform diameter and finish.

As the chip comes off in the turning operation, it is repeatedly broken up by shearing action into a kind of echelon formation. Each time the chip breaks or flows, the back pressure on the work is relieved, and obviously the finish produced depends on the nature of this process.

The foregoing hypothesis might be tested by experiments in which the friction on the top of the tool is deliberately increased and decreased over a considerable range. If the same result as regards chip formation, uniformity and size of the finished diameter is obtained with a high friction on the top of the tool as with a low friction, it would disprove the hypothesis.

The Use and Misuse of Marking Tools

By Raymond G. Schmidt
Vice-President, Geo. T. Schmidt, Inc.

PERMANENT marking on metal and many composition and wooden parts is done most successfully by steel stamps. Since permanent marking of all manufactured products is becoming more and more important for patent protection, record information, and advertising, and in view of the expense of marking tools, the subject of their proper maintenance should be of utmost interest in the shop.

The value of a steel marking tool is determined only after it has served its purpose. If two identical dies are purchased at the same unit cost and one of these makes 50,000 impressions while the other makes 100,000 impressions before failure, the first of these dies has cost twice as much as the other, although the initial cost was the same. Complaints on the life of steel marking tools are frequently traceable to misuse on the part of the operators.

There are several common misuses of steel stamps that reduce the number of impressions obtained from the die, even where they do not ruin it completely. The first of these is the practice of testing the dies or stamp on the nearest convenient piece of steel. It is an even chance that this convenient block of steel will be hard, or have hardened spots in it. The result is that the letters will be flattened or dulled.

Another common first fault is to set the die into the press and neglect to adjust the depth. If this does not result in a broken die, it frequently means that it is dulled, and will need recutting. Failures of this kind are often laid to improper heat-treatment of the die.

One of the uncontrollable enemies of marking dies is "spotty" stock. Frequently, a die will make 100,000 impressions in strip steel with perfect results, showing only wear on the smooth, shiny sides of the letters. Suddenly, without warning, the dies give way at various points. Some of the letters may flatten out and sink. In such a case, the fault is most apt to lie in the strip steel, which will be found to be spotted with hard places. Fine particles of very hard substances may be rolled into the stock, and when the die strikes one of these spots, that section of the die fails.

If a steel die is ordered for stamping an unfinished product, and the marking operation is laid out to follow a grinding operation, the die will give trouble and be short lived. This is due to the glazing of the steel in grinding, and from hard spots set up by the grinding wheel. If the dies are to be used on hard or semi-hard steel, such as saw blades, or plowshares, only a special grade of steel should be used for the dies, and the stamp manufacturer must take this into consideration. In order to make a die intelligently, the manufacturer must know the exact use of the die, so as to be guided in the kind of steel to use, the depth of engraving, the angle of the bevel, and the heat-treatment best suited for the material.

Neglect in cleaning dies is another fault attributed to the users of steel stamps. Scale, grit and oil will pack into the closed letters, and unless it is picked or brushed out frequently with a wire brush, dipped in gasoline, the dies will be ruined. This foreign matter packs so hard as to become a wedge, and the closed letters are literally split open.

It is a well-known fact that tool steel fails from repeated impact, and that the point in production where this failure begins depends upon the material being marked. The harder the material, the sooner this action begins. Failure may be staved off to some extent by cushioning the blow. If the parts being marked can be placed on a hardened block, which in turn is mounted on a soft block, the shock is to some extent relieved, and failure is thereby postponed.

The writer has in his possession several examples of large production dies, one of which has made over nine-million impressions on strip steel. The conditions under which the die was run were ideal, and the production unusual.

Marking tools are sometimes recut for the purpose of sharpening the letters to make a cleaner impression. While there is a slight saving in the labor cost over a new die, it has been proven repeatedly that such procedure is not an economy. The life of the tool is over 50 per cent spent after the first heat-treatment and annealing necessary for recutting. Decarbonization has to a certain extent taken place, and, while the tool may be hardened a second time to a satisfactory Rockwell hardness, it will not produce impressions in proportion to the cost.

Engineers and designers of marking tools can avoid breakage of these tools by proper layout or design of the blank itself. Since great pressure is required in imprinting a stamping die, it must be remembered that the body of the die must be heavy enough, in itself, to stand the shock. Thin flat blanks or T-shaped blanks with a thin cross for engraving should be avoided. Also eliminate holes in these blanks wherever possible, since each hole is a menace to heat-treatment.

Bevels to which the letters are cut are highly important factors in the life of lettering dies, and depend entirely upon the use to which the tool is to be put. An angle of 45 deg. for steel and 30 deg. for brass is standard practice for average dies, but this will change in stamping thin material or hot parts. For this reason, it is always essential that the stamp maker know the kind of material that is to be marked.

Uniformity of bevel is another feature which is important. If this is not carefully watched, and a letter is cut with 45 deg. on one side and 30 deg. on the other, the uneven side pressure will produce early failure.

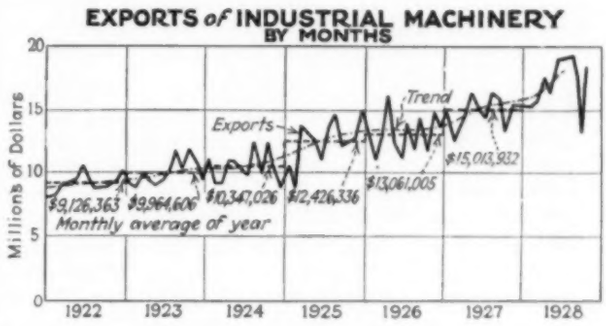
Activity in the Metal-Working Industry

Record Rate of Activity During November

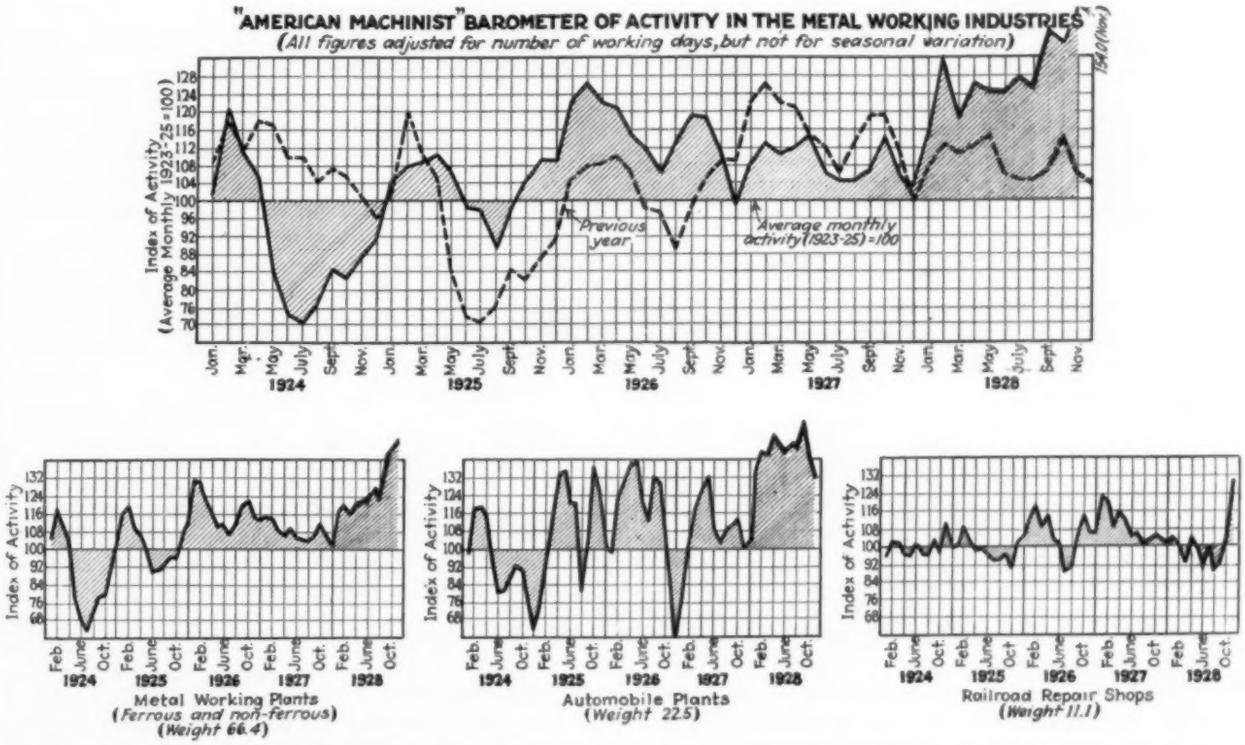
Reports on the consumption of electrical energy indicate that another record was made by the metal-working industry during November. Although there were two less working days in November than in October, the consumption of electrical energy in the ferrous and non-ferrous metal-working plants during November materially exceeded that reported for October.

The November rate of operations in the metal-working industry as a whole, after corrections are made for the number of working days, was 11 per cent greater than that for October, 46 per cent above that for November last year, and 8 per cent greater than the previous record rate of operations which was reported for last September. The metal-working industry appears to be enjoying to the fullest the prosperity which is prevalent throughout the nation in all but a few industrial groups.

Operations in the ferrous and non-ferrous metal-working plants during November were on a plane about 14 per cent higher than that during October, and about 55 per cent over November last year. These plants are operating at the highest rate ever reported for the industry. The railroad repair shops are also operating at a record rate, the November rate being about 22 per cent above October and 20 per cent above November last year. The automobile manufacturing plants, on the other hand, appear to have curtailed their operations slightly. In November these plants were operating at a rate about 6 per cent under October, but still about 31 per cent above November last year.



Information supplied by the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce states that the strictly industrial machinery exports during October were valued at $18,665,000. This represents a gain of 20 per cent over the figure for the corresponding month of 1927, and a gain of nearly 40 per cent over September of this year. The exports of metal-working machinery were 35 per cent greater, both for October and for the first ten months of 1928, than for the corresponding periods of 1927. The exports of construction machinery and conveying machinery continue their upward trend, as do internal combustion engines.



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· BOOK · REVIEWS ·

MECHANICAL POWER TRANSMISSION. By William Staniar, mechanical power engineer for E. I. Du Pont de Nemours & Company. Four hundred and nine pages, 5¾x9 in. Cloth board covers. Published by the McGraw-Hill Book Company, Inc., 370 Seventh Ave., New York, N. Y. Price $5.

BACK behind the scenes in every industrial plant stands a man whose duty it is to keep the wheels turning. There he has stood since industrial plants began, repairing, resetting, preventing breakdown. He is known by various titles that range from chief engineer through master mechanic to just plain George. It is natural, perhaps, that he has been given little attention by those who write for industry because he is behind the scenes. And as a result he has had to find most of his own answers to his multitude of problems. In fact it has remained for one of these men, the author of this book, to come out from the plant and help his fellows, by writing down his findings of many years service behind the scenes.

It is sufficient to say in review that its author knows from long experience whereof he writes. The book itself will go a long way to help the men who keep the plant wheels turning.

INSTRUCTION SHEETS FOR BURGHARDT'S MACHINE TOOL OPERATION. Parts 1 and 2—By Henry D. Burghardt, instructor in machine work, Wm. L. Dickinson High School, Jersey City, N. J. Each part has 27 loose-leaf 7½x5-in. sheets. Published by the McGraw-Hill Book Company, Inc:, 370 Seventh Ave., New York, N. Y. Price singly, 50 cents, bound together, $1.

THESE instruction sheets supplement the author's book, Machine Tool Operation, giving the sequence of operations to perform various tasks, as an aid in teaching. Although they have been intended especially for school use, it is evident that they should be helpful to the apprentice in directing his study of "standard" operations. In combination with the above work, these sheets should make it easier for the student of machine shop practice to become acquainted with correct methods.

TRADE ASSOCIATIONS: THE LEGAL ASPECTS. By Benjamin S. Kirch. Two hundred seventy-one pages, 6½x9¼ in. Cloth board covers. Published by the Central Book Company, 93 Nassau St., New York, N. Y. Price $5.

THE author of this book, once special assistant in anti-trust cases to the United States attorney in New York, recounts the evolution since the Civil War of the legal attitude toward business combinations as they developed through pools, trusts, holding companies, gentlemen's agreements, to their present form—trade associations. He also tells how, under social and economic pressure, the attitude of the courts has been altered from a strictly technical and legalistic interpretation of the anti-trust statutes to one of sympathy, uncolored by hostility and suspicion.

At the present time inquiries are being directed into what may legitimately be done by collective effort, and a progressive and constructive view of business statesmanship is being adopted. The problems of business are being viewed in the light of modern necessities rather than in the shadow of old legal concepts, formed when industry and business were much simpler. All this change has resulted in a vast accumulation of the "case law," and the substitution of fact for legal precept, of engineering and accountancy data for the finely spun arguments of lawyers. No longer are efficient and intelligent methods judged to be predatory merely because they are efficient and intelligent. Accountancy methods, uniform basing point systems, standardization, credit bureau, and collective purchasing functions are described at length in separate chapters.

MACRAE'S BLUE BOOK AND HENDRICKS COMMERCIAL REGISTER. Twenty-six hundred and thirty-five pages, 8½x11 in. Cloth board covers. Published by MacRae's Blue Book Company, 18 East Huron Street, Chicago, Ill. Price $10.

LISTINGS of many thousands of manufacturers in every division of industry form the content of the book. It is intended primarily as a reference for any firm or individual desiring to know the sources for nearly anything produced in industry.

The book is divided into three main sections to assist the reader. The first section is an alphabetical listing of names and addresses. The second section sorts this alphabetical list under a product list, also alphabetically arranged. The third section lists the names of companies whose products are known under trade names. These trade names are the basis for this section and are set up alphabetically.

The value of such a book is very well known to anyone who answers questions that have to do with sources for industrial products, with locations of companies and with identification of the makers whose names are secondary to the trade names of their products. Such a book can easily "earn its keep" and pay dividends in every worthwhile buying, selling and publicity agency in the industrial field.

OBJECTIVES AND PROBLEMS OF VOCATIONAL EDUCATION. Edited by Edwin A. Lee, professor of education, University of California. Four hundred fifty-two pages, 5½x8 in., cloth board covers. Indexed. Published by the McGraw-Hill Book Company, 370 Seventh Ave., New York, N. Y. Price $3.

A SYMPOSIUM on the subject contributed by nineteen authorities summing up the progress that has been made since the Smith-Hughes Act for Vocational Education became a law in 1917. The book opens with a history of vocational education by C. A. Bennett, editor of *Industrial Education Magazine*, followed by a discussion of our national responsibility in regard to it by two members of the Federal Board for Vocational Education.

Other chapters, of which there are sixteen, treat of trends in commercial education and in part-time education, trade and industrial education, vocational teacher training, and industrial arts education. Both the employer's and the worker's attitude toward such education are brought out in the one case by James P. Monroe, president of the Monroe Felt and Paper Co., Boston, and in the other by James J. Davis, Secretary of Labor of the U. S. The present trend is summed up by Prof. David Snedden of Teachers College, Columbia University, and a forecast is made in conclusion by Charles A. Prosser, director of the Dunwoody Institute, Minneapolis.

· TECHNICAL · ABSTRACTS ·

Research Work on the Chicago & North Western Railway

The Chicago & North Western was the pioneer railroad in the Middle West to establish a department for testing materials, both chemically and physically. The testing department is essentially a co-ordinating department, working directly with other departments concerned in the use of a wide range of materials.

The chemical control of water supply represents a large amount of work and requires not only field tests by a technically trained water supervisory force, but means also that several thousand analyses are performed each year on samples of water sent to the laboratory. Reclamation of used crankcase oil from motor cars and locomotives is one of the recent studies of the chemical laboratory. Considerable chemical work is also done in connection with samples of material sent in by the freight claim department to represent shipments alleged to have been damaged in transit.

One of the necessary tasks of the department is the formulation of specifications to govern the purchase and testing of various kinds of materials used by the railroad in the construction and repair of locomotives, cars and bridges. Specifications for materials to be practicable and workable must necessarily involve not only a knowledge of conditions in the field, but also conditions of manufacture. This means that the testing department must function as a connecting link between the user and the manufacturer, and every effort is made to improve the quality of materials through a study of manufacturing methods, the application of proper specifications, and careful attention to testing and inspection.

Rail Performance

All railroads are vitally concerned with the service performance of rails, which are often taken out of tracks for various causes other than wear. Rails, which have failed in service, are assembled at the Chicago shops, and once each year joint inspections of these are made with the representatives of the manufacturers.

The activities of the department extend over a very much wider field than that occupied by inspection work alone, or to the problems of any single department. Many wayside water softening plants have been installed for which chemical formulas are furnished and over which technical supervision is exercised to provide assurance that the water is properly treated in order to remove scale-forming matter. Another duty is investigative work in cooperation with the motive power and car departments. This has aided in adopting the use of new materials.

From the specialized nature of much of the work and the conditions under which it is done, the work of this department has not always been obvious, but many of the steps taken to bring about economies of operation on the road have a background in the work of its testing department.—H. D. Browne, *Railway Age*, December.

Brighten-Up the Dark Days

These are the days when the short daylight period emphasizes the need for adequate artificial lighting. It has been proved by actual test that increasing the lighting intensity in factories from an average of around 2 to 10 ft.-candles has increased production 12 per cent or better. This indicates an important opportunity for production economies. Among the things to do that will offset the lack of adequate natural lighting in the morning, and particularly in the afternoon, is to go over the entire layout with a view to determining whether or not the present circuits are adequate to carry an additional load. If not, it is imperative to consider the cost and advantage of installing new circuits.

Another point to check over is that of the reflectors that are used. Many advances have been made lately in the design of reflectors, both in the open and in the closed types.

It should be remembered that dust and slight discoloration on the globes, or dirty reflectors, will drop lighting efficiency by 40 per cent within a short period. Another aid to better lighting is repainting the walls and ceilings. If repainting is necessary, preference for semi-gloss, egg-shell finish is desirable.

Every extra minute that natural lighting can be utilized saves on the power bill. Hence window cleaning should be on the maintenance program at this time of year. The use of special light-diffusing and reflecting glass in the upper parts of windows, which are depended upon as the source of light for deep rooms, should be considered. There are a number of prismatic glasses, which have the properties of throwing the light rays in a horizontal direction, and which have a marked capacity for improving the lighting in areas remote from the windows.—C. Stanley Taylor, *Industrial Engineering*, December.

Baking of Japan and Shrivel Finishes

In the manufacture of phonographs, the hidden metal parts entering into the construction receive one coat of finishing material consisting of japan. The surfaces, which are exposed to view, receive either two or three coats, these consisting of either shrivel or crystalizing varnishes. An oven equipped with a dip tank is used for baking the plain japan, while a special double-compartment oven is used for baking the finish coats.

Baking of the plain japan coat is performed in an oven 44 ft. long, 9 ft. wide, and 7 ft. high, and equipped with a conveyor. Parts are placed on the cross bars of the conveyor, and are immersed automatically into a japanning tank, then carried along over the drain board, and finally into the oven through a sealed opening. A motor-driven pump is used to circulate the japan in the drip tank. While entering the oven the conveyor follows a horizontal path of 31 ft. and then changes to an inclined path emerging through a bottom opening where the work is unloaded. The oven is indirectly fired by burners firing into three sets of combustion chambers from which the gases are conducted through polished radiator tubes located vertically along the walls of the oven. All heat for drying the products is supplied from these tubes, no flame or combustion gases entering the heating chamber. Air for ventilation enters the drying chamber through two openings at either end, and is exhausted through dampered openings at several points along the oven. The temperature is thermostatically controlled. A temperature of 400 deg. F. is maintained.

Baking Novel Finishes

A second oven, which is of the double-compartment type is used for the baking of shrivel varnishes and crystal finishes. The first compartment at the entering end of the oven comprises a space 9½ ft. long, and is known as the crystalizing compartment. It is heated by two open burners to produce the necessary reducing atmosphere.

The second chamber is heated by three sets of closed heaters into which two gas burners are projected. In this case also, the gases from the heaters are conducted through vertical radiating tubes along the inside wall of the oven. Air for ventilation is admitted at several points along the lower part of the baking chamber and leaves through shuttered openings at the top. The baking time may be varied from 58 to 230 min., giving a range of time from 12 to 50 min. in the crystalizing compartment and 46 to 180 min. in the baking chamber. A temperature of 275 deg. F. is maintained in the preheating chamber and 375 deg. F. in the baking chamber.

In the baking of shrivel finishes an exceedingly accurate control of temperature is necessary to produce exactly the kind of shrivel that will give the most pleasing appearance. A fast bake and high temperature in the preheating chamber is undesirable; likewise, a low temperature in the preheat zone and slow conveyor speed will produce baking difficulties.—I. Stanley Wishoski, *Fuels and Furnaces*, December.

IDEAS · FROM · PRACTICAL · MEN

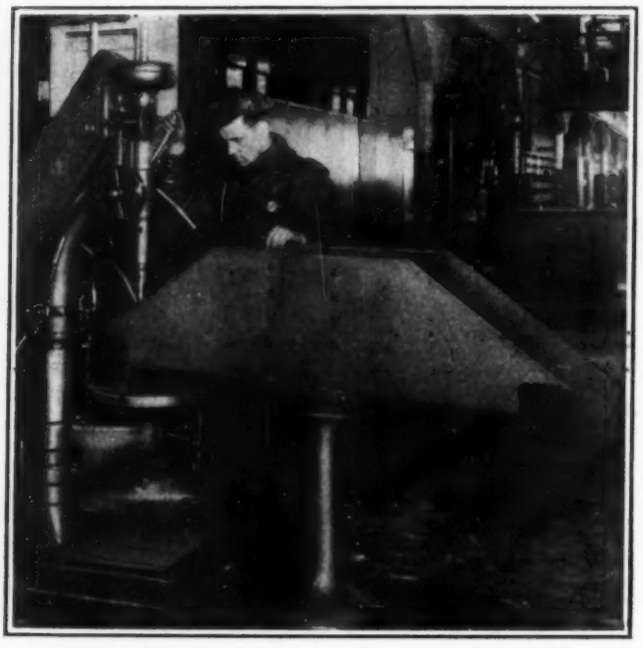
The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from a minimum of five dollars upwards, depending upon their merit

Drilling Support for Heavy Work

By R. E. Marks

The illustration shows a method used in a large car repair shop for drilling holes in the ends of a heavy and awkward piece that forms part of the under frame structure. By providing a pedestal of suitable height to support the center of the piece and allow one end to rest on the drilling machine table, very little effort is required to handle the piece under the drilling spindle or to reverse the whole thing by swinging it on the pedestal.

In this way, both ends can be readily drilled without



Pedestal for supporting work being drilled

difficulty and no hoist is tied up, except when handling the piece on or off of the pedestal. The lever under the drilling-machine table makes it easy to swing the table arm on the column, so as to get at any desired part.

Measuring Spring Deflection

By Frank C. Hudson

A method of measuring the deflection of coil springs used in connection with a crankshaft balancing device is shown herewith. It is in use in the plant of the Oakland Motor Car Company. The substantial framework is fastened to a heavy base and spans the platform of the scales used in weighing the load on the springs.

On the portion of the stand that supports the balancer

Accurate testing of spring deflection

is a dial indicator that shows just how far the springs are compressed under a given load applied by a screw in the yoke over the scale. The dial indicator must show a given deflection for a stated load as applied by the hand wheel.

Use of Aluminum for Jigs

By J. S. Browne

Where lightness in jigs is an important requirement, such as drill jigs that must be turned over repeatedly to drill from four or six sides, aluminum bodies can be employed to good advantage in place of cast-iron bodies.

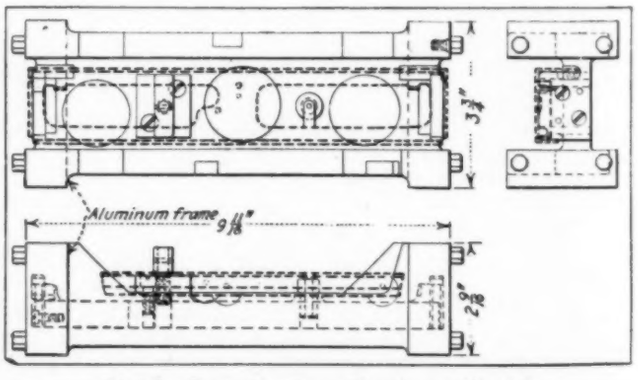


Fig. 1—Example of an aluminum jig body

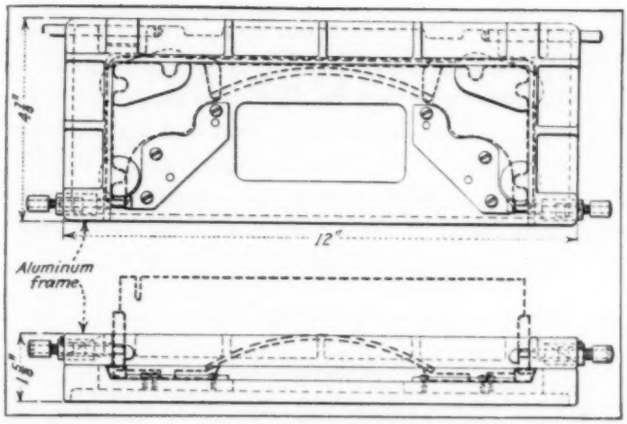


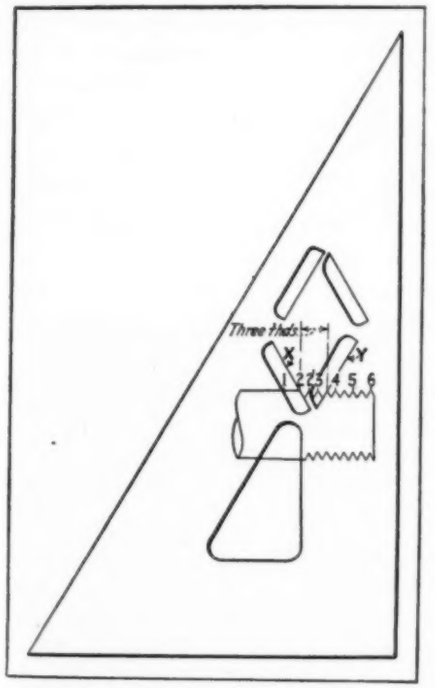
Fig. 2—Another type of aluminum jig

In the jig shown in Fig. 1 the weight was reduced from nearly 9 lb. to approximately 3 lb. by making the body of aluminum. When it is considered that a jig of this kind is handled eight hours a day by a woman operator, this saving in weight is an important consideration. Another application was in the welding fixture shown in Fig. 2. This fixture is used for holding together three sheet-metal parts of a portable typewriter body cover while six spot welds are being made. The production is 88 complete assemblies per hour by a boy operator, made possible by the rapidity with which the light jig can be handled.

Triangle for Drawing V-Threads

By Joseph E. Fenno

I have devised a means by which V-threads may be drawn very speedily in comparison to the old method of laying out each thread distance, drawing one side of all the threads, turning the triangle over and doing the remaining sides. In the latter case the draftsman is in a cramped position, and has insufficient light on the pencil point. When using the triangle as shown, all angular lines are drawn with the pencil point in plain view. Before using the triangle, spaces are laid off on the screw diameter, equivalent to two full threads. The first space is shown at 1, the next at 2, etc. There is also a distance, 2 to 2′, laid off, equal to one thread. With the triangle against the tee square, the latter is positioned until the edges *X* and *Y* pass through the points 1 and 2′ respectively. In this position the angular line down to the left from 2′ is drawn along edge *Y*. The triangle is now moved over to the right on the tee square until edge *Y* passes through point 3, and the angular line down to the left from 3 is drawn. The triangle is again slid to the right until edge *X* passes through point 2 and from the latter point a line is drawn down to the right. In each position of the triangle the edges *X* and *Y* alternately fall upon any one of the points that are numbered, the sides of all the threads being completed in this manner. The bottom threads are drawn the same way with the two similar but inverted slots shown above those described. The saving of time and the better appearance of the drawing make the use of this method worth while.



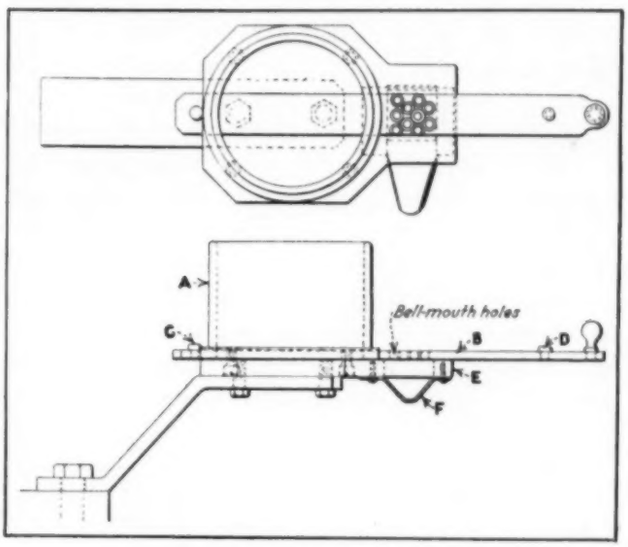
Slots in triangle to facilitate drawing V-threads

Fixture for Handling Small Balls

By Harry S. Taylor

The average person knows it is quite a difficult task to assemble small ball bearings with the fingers, especially when the balls are as small as $\frac{3}{16}$ diameter.

We were manufacturing bicycle hubs for the foreign trade, where they require loose bearings in preference to ball retainers commonly used in this country. In each end of the front hub they require ten $\frac{3}{16}$ balls. We employed girls for the assembly of these hubs owing to the fact that it was light, clean work, but found difficulty in getting the correct number of balls in each and every bearing. Finally we designed and built the fixture shown in this sketch and our trouble was ended.



Apparatus for counting balls

The balls were placed in the pot *A*. We drilled ten $\frac{1}{4}$-in. holes in the slide-bar *B*, making the holes bell-mouth on the top side, so that when the slide *B* is pushed in the balls drop into the holes. Stop pins *C* and *D* prevent the slide-bar from going too far either way.

It was almost impossible to push the slide-bar under the balls and not bring out the required number, which then dropped through the opening in plate *E* into the chute *F* where they rolled directly into the end of the hub. This fixture not only assured the correct number of balls, but it also increased production on this operation about 200 per cent.

American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

Established 1877

Too Many Distractions

WHATEVER else may have come out of the annual meeting of the American Society of Mechanical Engineers there is no doubt but that many of the more responsible members went home with a general impression of futility. One man who wanted to listen to the discussion at four of the technical sessions was prevented by meetings of standardization and research committees of which he was a member from attending any of the technical meetings. Another man with even wider interests spent a total of ten minutes in technical sessions. These two cases, unfortunately, were not exceptional.

Now, what is it all about? Are the technical sessions worth attending? If so, why arrange other meetings so that many of the men best qualified to discuss the papers are unable to be present?

Are the standardization and research committees doing enough to warrant their continuance? Evidently, or the large corporations would not continue to pay the expenses of their engineers who hold membership on these committees. On the other hand, is work of this sort strictly the task of the engineer through his engineering society? Is it sufficiently educational to justify the time it takes from his attendance at technical sessions which are generally truly educational?

The principal valuable return from the work of research and standardization committees is to industry. Why should not industry pay for the work instead of expecting the none-too-well-paid engineer to do so? The employers may feel that they are doing enough in paying the expenses of their men at engineering society meetings, but the fact is that they more than get that small amount back in the renewed vigor with which the engineers attack their problems after the stimulation of contact with other engineers, and in the new ideas picked up at the meeting and brought back to be used. The returns from research and standardization, often of major proportions, are clear velvet.

Running a big engineering society so that every member feels that he is getting his money's worth is difficult, if not impossible. But when so many members express discontent with the press of engagements that kept them away from the most important part of the meeting it is time to inquire if some means cannot be found to clear the way for the technical programs. Perhaps a reduction in the number of technical sessions would be the right move, and possibly the committee work should be done at some other time, or not at all. At any rate, some change is desirable.

Back-Scratching

BACK-SCRATCHING—in other words, buying certain machines or supplies because the party of the second part buys something from you—appears in many forms. Railroads, for example, sometimes place orders for machinery with jobbers who do not handle the machines best suited to their needs—because the jobber reminds them of the large tonnage they send over the railroad in question. Builders of electrical apparatus frequently feel obliged to split orders between several builders of machines who use their motors. And machine builders themselves occasionally play the same back-scratching game by buying from the builder who uses their machines, whether or not the machines are best suited to their needs. They call it reciprocity, however, instead of back-scratching.

There are, probably, few cases where selections made in this way are economically sound. It is the jobber's duty to his stockholders and customers to ship over the railroad giving him the best service. It is likewise the machine builder's duty to select a motor that will give his customers the best satisfaction, regardless of whose machines the motor builder uses in his own shop. And machine builders who load their shops up with the machines of builders who will trade for theirs are usually handicapping their production men in lowering costs.

The selection of machines or materials should be made on merit alone. Machines last too long to be saddled on the shop because the maker buys one of your machines, one that he should buy to get the best, and probably would.

Reciprocity is a sweet sounding name for what is really back-scratching, or worse, brow-beating. Unless merit is the chief consideration in the selection of machine equipment, the whole machine building industry pays the price—which is, and must be, passed on to the customers. The man who selects the best regardless of whether or not the maker buys his product is in an enviable position.

· SHOP · EQUIPMENT · NEWS ·

"Wilco" Series 104 Pipe Threading Machine

REGULAR pipe sizes that may be threaded on the Series 104 machine range from 1 to 4 in., but extra sizes include ½ and ¾ in. Bolts from ¼ to 2 in. in diam. may also be threaded. The machine has been developed by the Williams Tool Corporation, Erie, Pa. With regard to the cutting of nipples, the minimum length that can be handled without a holder is 5 in. A separate holder is required for each regular size.

Four removable chasers are used for cutting threads. Each size of pipe requires its own set of high-speed steel dies, and the sizes can be changed rapidly. The dies are held in an adjustable mechanism, which is operated by moving the hand lever, shown above the die-head, along the graduated face to the desired size. Lubrication of the dies is effected by means of nozzles built into the die-head itself and delivering an ample supply of coolant. The traverse of the head along the ways is 15 in. Lathe-type tools for cutting off, reaming and chamfering are provided. The heavy, three-jaw chuck of simple design is carried by a spindle running in large bearings provided with automatic lubrication by means of a chain dipping into a bath of oil. The chain housing can be seen at the left of the chuck. A bore of 5½ in. is provided for the spindle, thus permitting 4-in. pipe with couplings to be passed through it. Four changes of the spindle speed are provided to give a range of cutting speeds suitable for the pipe sizes handled. These are 13.5—18.2—27.3 and 40 r.p.m. A reverse gear is provided. All controls are centralized.

Drive to the spindle is effected from the 3-hp. motor through a chain drive to the four-speed gearbox, containing cut steel gears, up to the spindle clutch. Both the clutch, which has forward and reverse, and the gears run in oil. The floor space occupied is 5 ft. 2 in. by 2 ft. 0 in. The weight is 2,000 lb. net.

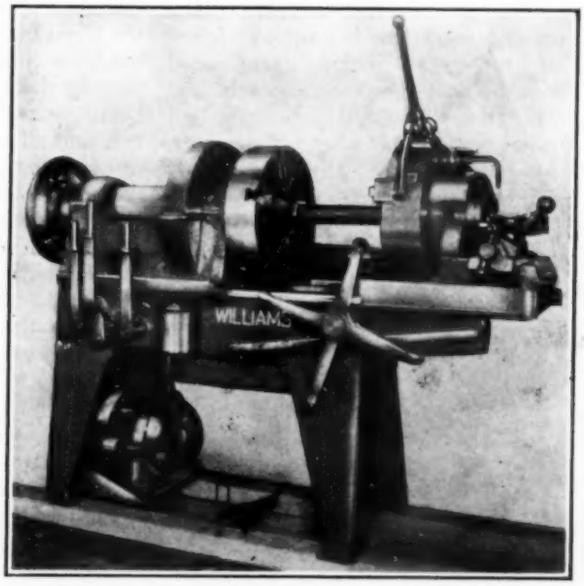


Fig. 1—"Wilco" Series 104 Pipe Threading Machine

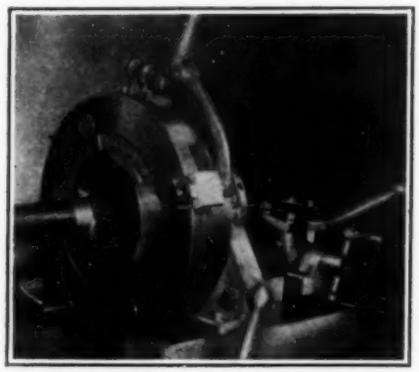
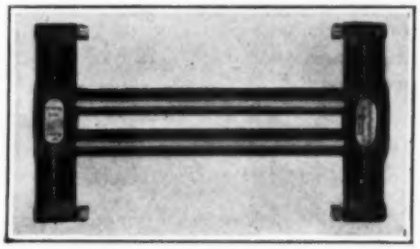


Fig. 2—Close-up of the diehead and operating mechanism

"Standard" Adjustable-Limit Shoulder Snap Gage

Double supports, insuring great rigidity and eliminating all spring in gaging, is the feature of the improved adjustable-limit shoulder snap gage being placed on the market by the Standard Gage Company, Poughkeepsie, N. Y. The two supports are of steel tubing for lightness, and are attached in a rigid manner to the head. The gaging pins for the external gage are flat, while those for the internal gage have ball points.



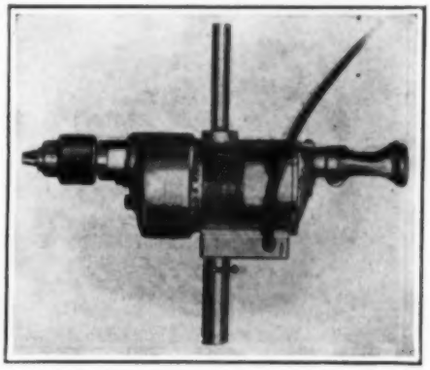
"Standard" Adjustable-Limit Shoulder Snap Gage

The pins are held securely in the heads by the "Standard" patented locks, insuring rigidity.

The gage has a ½-in. range of adjustment after setting the clamping and adjustment screws. It can be sealed with wax to prevent tampering. The range of sizes regularly furnished is from 4 to 24 in., but larger sizes are made up as required.

Clark ⅝-Inch Low-Speed Electric Drill

To permit easy drilling of the tough steel now being used in automobile manufacturing and other work, the James Clark, Jr., Electric Company, Louisville, Kentucky, has brought out a ⅝-in. low-speed electric drill. In construction this drill is similar to the firm's standard No. 2-U size, except that it has a speed of 250 r.p.m. when loaded. It is recommended for indus-



Clark ⅝-Inch Low-Speed Electric Drill

trial work where severe service is encountered.

The unit method of design used in this tool makes for easy cleaning, inspection and repairs. No wires are run through the handles, or from one sub-assembly to another, and all connections are on the main casing. The switch lever is directly under the operator's thumb or finger. Universal chucks are attached to the spindle by a taper fit, which makes for true running, and for easy removal when necessary.

"Rego" Gas-Vibrator Acetylene Generator

Three types of acetylene generators have been placed on the market by the Bastian-Blessing Company, 240 East Ontario St., Chicago, Ill. The generator shown in the illustration is equipped with an XL regulator, which will be described later. All three types of generators are available in 30-, 60-, and 100-lb. sizes. The types A and N are for stationary use, the first being of a type approved by the Underwriters. Both of these generators are suitable for operating a few torches only. The style P generator is an automatic type approved by the Underwriters for portable use. The 30- and 60-lb. sizes can be had with or without the regular two-wheel truck. The 100-lb. size is furnished only without the truck.

All connections are either cast as an integral part of the body or are gas welded, and all seams are gas welded. Parts subject to rust are either hot galvanized or covered with an acid- and rust-proof coating.

The power that operates the gas vibrator generator is the acetylene gas itself as it leaves the generator. The apparatus is started after filling with water and carbide by moving the lever of the gas outlet valve back and forth three or four times between the start and stop positions. This movement agitates the feed valve and shakes a small quantity of carbide into the water. The gas resulting goes to the vibrator bell on its way to the flash-back chamber. The bubbling moves the bell up and down, this movement being transmitted through connecting rods to the feed valve, thus causing it to vibrate and shake more carbide into the water. The generator thus makes automatically and accurately the exact amount of gas required. The pressure regulator, of which a cross-sectional diagram is shown in Fig. 2, serves as an auxiliary governor of the movement of the feed valve. The regulator may be set at any desired operating pressure from 1 to 14½ lb. per sq.in., and the gas will be delivered at the outlet at a pressure within ½ lb. of the set pressure at all times, according to the manufacturer.

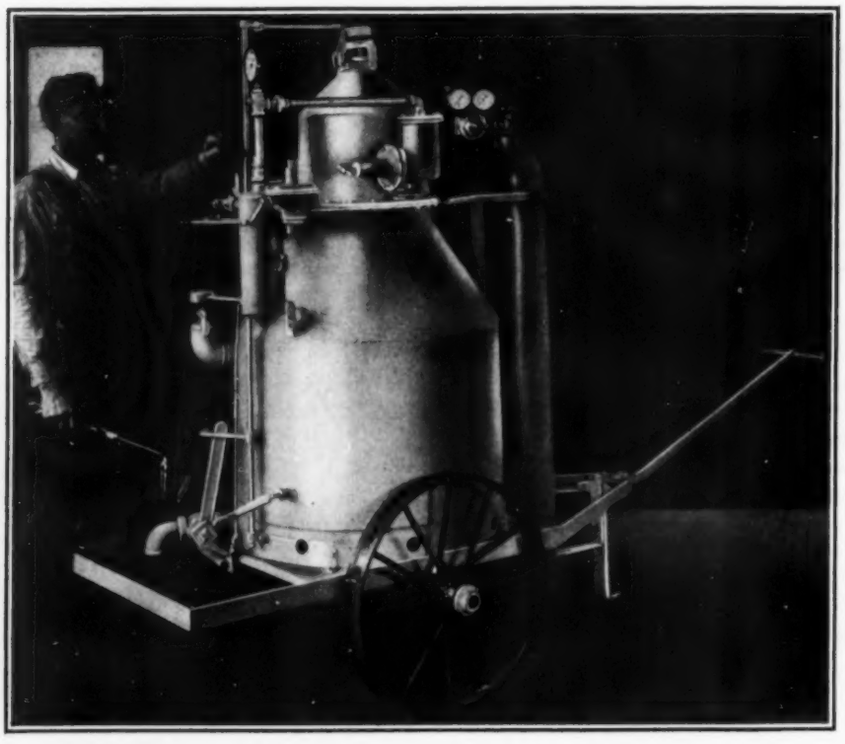


Fig. 1—"Rego" Gas-Vibrator Acetylene Generator equipped with an "XL" Regulator

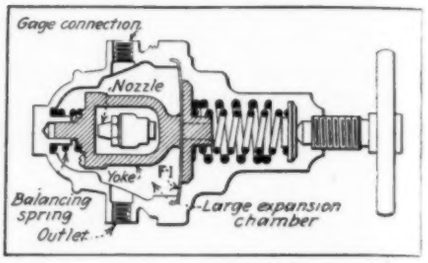


Fig. 2—Cross-section of the "Rego XL" Regulator

The lever that controls the gas outlet and feed valve is attached to a quadrant so that the opening between the feed valve and hopper can be readily adjusted for any slight variation in the size of the carbide. All moving parts are of sturdy construction and all assemblies are constructed to prevent clogging. The bulk of the weight of the generator is carried directly over the axle, thus permitting a man to move it easily. Heavy, broad-tired, roller bearing wheels are provided, and the truck extension prevents the generator from tipping over backwards.

The "XL" regulator shown in Fig. 2 is suitable for gas pressures up to 2,000 lb. per sq.in. The gas enters the regulator at the left. If the regulator is closed, the seat is in contact with the nozzle, which prevents the gas from going beyond that point. When the operator is ready for the gas, he turns the adjusting screw to the right until the gage registers the desired pressure. Turning the adjusting screw to the right causes the diaphragm to move the seat away from the nozzle, thus allowing the gas to flow from the storage tank into the expansion chamber of the regulator. The gas continues to flow into the expansion chamber until sufficient pressure is built up to overbalance the pressure of the adjusting screw spring. The outlet of the regulator is controlled by the torch valve. When the torch valve is open, the gas flows from the regulator, diminishing the pressure against the diaphragm and allowing the spring to force the seat away from the nozzle.

The nozzle of the regulator adjusts itself to supply any volume of gas up to capacity at the desired fixed pressure. Should foreign material lodge itself on the seat, the resulting excess pressure against the diaphragm will force the seat into the nozzle and stop the flow. All interior parts of the device are of brass or bronze. The device is built with a patented safety sealing edge, which cuts the diaphragm and allows the gas to escape harmlessly before any dangerous excess pressure can be built up.

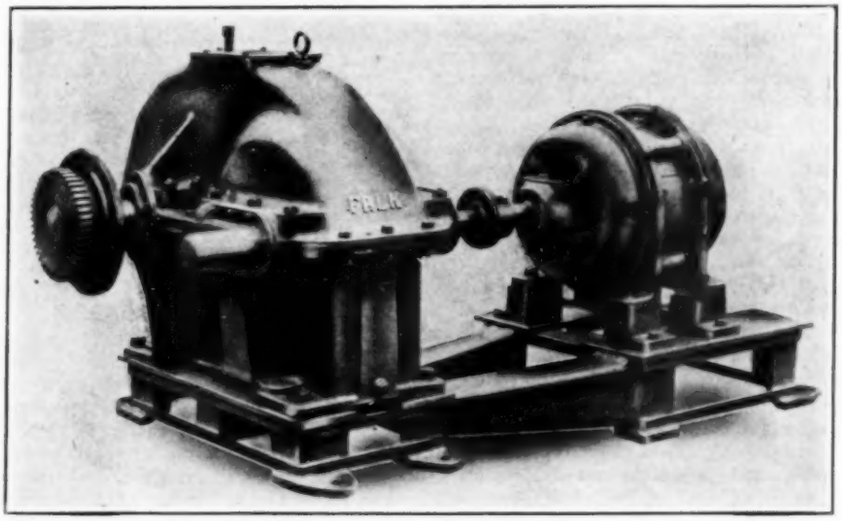
Falk Improved Herringbone Speed Reducers

Certain refinements have been made and sizes added to the line of speed reducers manufactured by the Falk Corporation, Milwaukee, Wis. These speed reducers were originally described in Vol. 66, p. 512, of the *American Machinist*. The sizes that have been added include four single-reduction, three double-reduction, and three triple-reduction units, also nine sizes of single-reduction units with vertical centers, making at present a total of 48 different sizes.

The speed ratios are as follows: Single-reduction units of both horizontal and vertical centers types, up to 10 to 1; double-reduction units from 10 to 1 up to 70 to 1, and triple-reduction units from 70 to 1 to 300 to 1. A double-reduction unit mounted on a welded motor bed is shown in the illustration.

A complete line of welded steel motor beds has been added, and any unit may be obtained with this type or with a cast-iron bed. The welded steel motor beds are desirable for mountings that are not rigid. Alloy steel shafts are now used to withstand heavy shock loads and sprocket pulls. The pinions used are heat-treated chrome-vanadium steel forgings. The larger gears are made of a special gear material. Through bolts of heat-treated steel are used throughout the entire line and assure oil-tight joints. The cover can be removed and put on again without trouble.

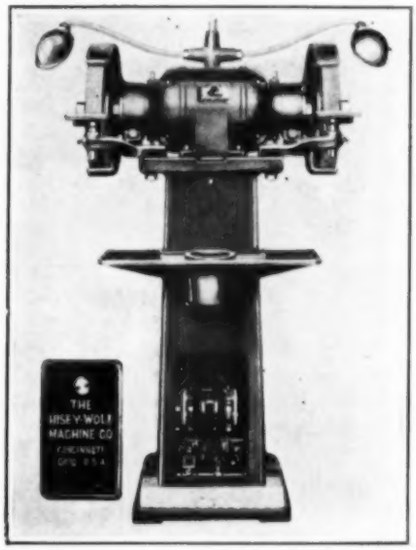
The airplane-type sleeve bearings have been retained. The babbitt for these bearings is applied by a special method so that mechanically-solid units result. A plate attached to the base of the gear case gives instructions as to the proper grade of oil to be used under every operating temperature and condition.



Falk Improved Double-Reduction Speed Reducer mounted upon a welded steel motor bed

Attachments for Hisey-Wolf Grinders

Two attachments, which can be placed on the standard line of buffers and grinders, have been announced by the Hisey-Wolf Machine Co. Cincinnati, Ohio. These are a treadle switch, which automatically shuts off the machine, and an automatic electric light control. Both attachments are shown in the accompanying illustration. The treadle extends the entire width of the column, thus allowing simultaneous operation by two workmen without hindering or interfering with each other. The door in the column is removed to show the internal electrical arrangement.



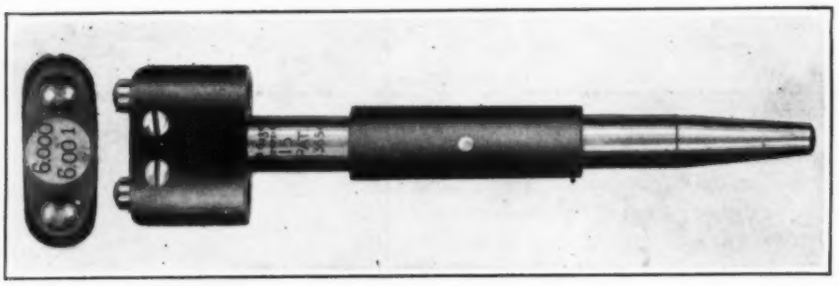
Hisey-Wolf Grinder fitted with automatic light control and automatic treadle switch

The automatic grinder lights burn only while the grinder is being used. They operate automatically with the "on" and "off" of the motor control switch. Flexible metal holders permit adjustment instantly to any desired position. By the use of this attachment, current is saved since the human factor is eliminated.

"Standard" Adjustable-Limit Pin Gage

The accompanying illustration shows the adjustable-limit pin gage patented and marketed by the Standard Gage Company, Inc., Poughkeepsie, N. Y. This gage incorporates the "go" and "no go" feature in one gage by means of adjustable gaging pins mounted in the head, each of which gives a predetermined dimension with the stationary pin. This construction eliminates dependence on the "feel" of the operator.

The pins are adjustable for wear, and for size within the range of the gage. They are held rigidly in the gage by a patented pin-locking device, insuring the same accuracy as with a solid gage. The gage measurement is taken from the fixed end of the gage radially to the pins, and, in checking internal measurements, the operator can gage rapidly within the tolerance limits by a simple rocking



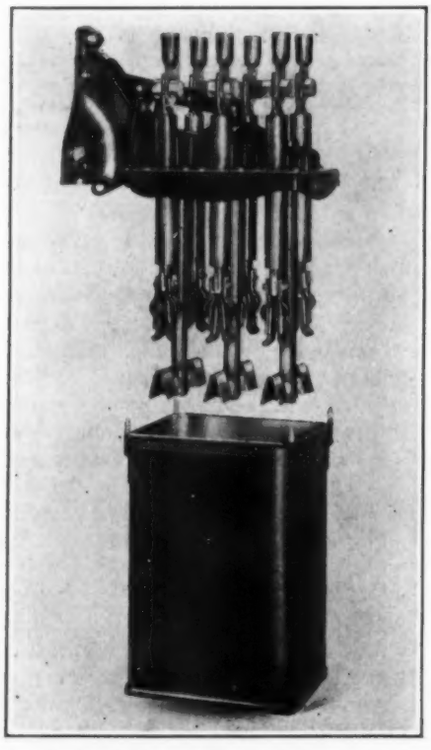
"Standard" Adjustable-Limit Pin Gage

motion of the gage. The regular sizes of the gage run from 4 to 24 in., but gages for larger internal diameters are made on order.

[This announcement, which was originally published in last week's issue, is being republished because the illustration of the snap gage described elsewhere in this issue was inserted through a typographical error.—EDITOR.]

General Electric Type FK-33 Oil Circuit Breaker

Intended for small plant and industrial installations, the type FK-33 oil circuit breaker has been placed on the market by the General Electric Company, Schenectady, N. Y. The breaker is compact in design, has small overall dimensions, and is easy to operate. The device is built in several sizes, rated at 4,500 volts, 200- and 400-amp. capacities, in 2-, 3-, and 4-pole, single- and double-throw types, having interrupting capacities of approximately 20,000 kva. at the rated voltage.



General Electric Type FK-33 Oil Circuit Breaker

Trade Publications

AIRCRAFT PLUMBING COUPLINGS. The Parker Appliance Co., 10,320 Berea Road, Cleveland, Ohio, has published a catalog on the Parker aeronautical tube couplings, which, although it does not list the complete line, shows many different types manufactured in sizes for ¼-in. O.D. tube to sizes suitable for 3-in. O.D. tube. The standard shapes are intended to meet the majority of aeronautical plumbing requirements. The methods of applying these couplings are shown by means of photographs. Other products listed include refueling valves, angle valves, and plug shut-off valves. The bulletin contains sixteen 9x6-in. pages.

MILLING CUTTERS. The Ingersoll Milling Machine Co., Rockford, Ill., has published Bulletin No. 49, entitled, "Ingersoll Milling Cutters," which illustrates all the standard and many special types manufactured. The tools shown are face milling cutters, cutters adapted to Giddings & Lewis machines, helical inserted-tooth milling cutters, staggered inserted-tooth channeling cutters, shoe and wedge and driving box cutters, arbor mills, inserted-tooth solid-shank cutters, boring heads and tools, end mill cutters and shell end mill cutters. Each type of tool is thoroughly described and illustrated and the specifications of many are given. The catalog contains 39 11x8½-in. pages.

PLATFORMS, SKID, STEEL-BOUND. The Stuebing Cowan Company, Cincinnati, Ohio, has published a catalog entitled "Stuebing Steel-Bound Platforms," which lists the advantages of steel-bound platforms and illustrates the points made by means of diagrams. Eight standard types of these platforms are available, all being shown in the catalog. The pamphlet contains fourteen 11x8½-in. pages.

SPEED REDUCERS. The Falk Corporation, Milwaukee, Wis., has published Bulletin No. 190, on the Falk herringbone speed reducers. This bulletin lists eighteen new sizes of reducers in standardized ratios, simplified rating tables, and a complete line of welded steel motor beds. In addition to the three types of herringbone reducers, described in the bulletin, there is a large section composed of pictures of installations. The bulletin is handsomely printed and illustrated.

STEEL LOCKERS. The Durabilt Steel Locker Co., Aurora, Ill., has published Bulletin No. 6000 A, which illustrates and describes twenty-five various types of steel lockers, basket racks and trucks. These products are available in 163 sizes. Exterior and interior views are given as well as close-ups of important features. Specifications are listed. The pamphlet is printed on a continuous sheet so that it is easy to compare the various types.

UNIT HEATERS. The American Blower Corporation, Detroit, Mich., has published Bulletin No. 7418 on "Sirocco" unit heaters in both high- and low-pressure types for floor and ceiling applications. The characteristics and methods of installation are taken up at some length. Next, the function and design of each part is discussed. Finally, application diagrams, piping diagrams, dimension diagrams, and ratings are listed. The catalog contains 32 11x8½-in. pages.

BEARINGS AND THEIR LUBRICATION. The Standard Oil Co., (Indiana) Chicago, Ill., has published Engineering Bulletin B-97, entitled "Bearings and Their Lubrication," for the instruction of lubricating salesmen. Among the subjects discussed are: Ball and roller bearings, bearing metals, bearings with sliding friction, bearing troubles, classification, distribution of oil in bearings, oil packing and retainers, properties of lubricants and their application to bearings, and cost factors. Many fine illustrations are used to explain the text. The bulletin contains twenty-six 11x8½-in. pages.

V-BELT HANDBOOK. The L. H. Gilmer Co., Tacony, Philadelphia, Pa., has published a booklet entitled, "Handbook of Small Belt Drives—1928." Such topics as when to use a belt drive, the fundamental purpose of a belt drive in both flat and V-types, designing the pulleys, drives with three or more pulleys, and quarter-turn drives are discussed. The horsepower ratings of V-belts and the formulas relating to V-belt drives are given. The catalog is profusely illustrated and contains 44, 9x6-in. pages.

NEWS OF THE WEEK

Pratt & Whitney in Large Aircraft Merger

FORMATION of one of the largest units in the airplane industry, having securities with a market value in excess of $150,000,000 and embracing companies which manufacture engines, construct planes and transport air mail, passengers and express, has been announced. The new company, which will be known as the United Aircraft and Transport, will be created by merging the Pratt & Whitney Aircraft Corporation, the Chance Vought Corporation and the Boeing Airplane and Transport Corporation.

United Aircraft and Transport will be organized as a holding company, owning all of the common stock of its three subsidiaries as well as 70 per cent of the stock of Pacific Air Transport. The consolidation is being effected under the auspices of the National City Co., of New York, and the Pacific National Bank of Seattle.

All of the subsidiary concerns will continue with the same respective managements and official personnels and with no change in the individual policies pursued heretofore. The consolidated corporation will have an authorized capitalization consisting of 1,000,000 shares of 6 per cent preferred of $50 par and 2,500,000 shares of common stock.

Stockholders of Niles-Bement-Pond Co., which controls half of the common of Pratt & Whitney, will receive approximately 2¼ shares of common of United Aircraft and Transport for each Niles-Bement-Pond share now held. Issuance of common shares of the new corporation has been authorized in connection with the acquisition of the entire capital stock of Chance Vought.

William E. Boeing, president of the Boeing Airplane and Transport Corporation, will be chairman of the board of the new company. Frederick B. Rentschler, president of Pratt & Whitney, will be president, while Chance Vought will be vice-president and Charles W. Deeds secretary and treasurer.

Lancia to Produce Cars in Poughkeepsie

Lancia Motors of America, Inc., has been incorporated under the laws of the State of New York to build and sell Lancia cars through an arrangement with the Lancia Automobile Co., of Turin, Italy, whereby it will have use of all the Lancia patents. Mr. Lancia is chairman of the board of the American company and will supervise the construction of the car. The company has acquired the old Fiat plant in Poughkeepsie, N. Y., where 129,000 sq.ft. of floor space will be available. The building is of reinforced concrete. An initial production of 3,000 cars per year is planned, although there is sufficient space for producing 25,000 cars per year. In order to furnish working capital for the production of these cars, 80,000 shares of 8 per cent preferred stock, par value $25, and 40,000 shares of common stock, par $5, are being offered the public through the Federal Securities Corporation. Authorization is for 100,000 shares of both preferred and common stock.

Brown-Lipe Gear Company Sold to Bankers

The Brown-Lipe Gear Co., one of the largest independent automobile gear manufacturers, of Syracuse, N. Y., has been sold to William Schall & Co., New York bankers, for $3,400,000, it was announced by Alexander Cowie, Syracuse attorney. The plant covers approximately 6 acres, is running on a full-time basis and employs about 1,000 persons. Definite plans as to the future of the company and its management have not been announced. The firm is not connected with the Brown-Lipe-Chapin Co., a division of General Motors Corporation, although it was sponsored by the same group of Syracuse business men.

Executives to Discuss Production Problems

The 1929 production executives' conference of the American Management Association will be held at the William Penn Hotel, Pittsburgh, February 27-28 and March 1, according to an announcement made by Oscar Grothe, vice-president of the White Sewing Machine Corporation and vice-president in charge of the production executives' division of the association. The theme of the conference will be: Factory and Operating Organization—Specialists, Their Activities, Functions and Relationships with the Line Organization and to Other Specialized Departments.

The conference will open with a half day session on Theories of Organization, the opening paper to be presented by Thomas R. Jones of the Cincinnati Milling Machine Co. Other half days will be devoted to accounting departments, engineering departments, and the place of the consultant in an industrial organization. There will also be a session on planning department operation and relationships, including production control, inventory control, time study, wage setting and similar departments, as well as a session on maintenance, repair and toolroom departments. In addition there will be a discussion of the functions of specialists in production and operating departments.

Aeronautical Notes

The Stinson Aircraft Corporation will soon begin the construction of a new factory unit adjacent to the Detroit-Wayne Industrial Airport, Wayne, Mich. The building will be of one-story construction and will provide 85,000 sq.ft. of floor space. When completed the company will move its manufacturing operations from Northville.

One of the first "Rover" airplane engines being built by the Michigan Machine Co., Detroit, has been installed in the first of a new series of planes being produced by the Driggs Aircraft Co., of Lansing, Mich. The Rover engine is a 4-cylinder-in-line inverted, air-cooled type, weighing 210 lb. Both the plane and engine are expected to be in quantity production early next year.

The Knoll Aircraft Co. recently broke ground for a new three-unit factory at Wichita, Kan. The first unit is a paint and dope room 50x100 ft. while the main units will be 150x200 ft. The third structure is an office and administration building. The personnel of the company will be largely German, headed by Felix W. A. Knoll, designer and vice-president. A number of prominent German aeronautical engineers will arrive in Wichita next month.

The Glenn H. Martin Co., Cleveland, has leased 40,000 sq.ft. of space in the Colgate warehouses of the Canton Co., Baltimore, Md., with an option on an additional 20,000 sq.ft., and will install machinery for the production of a new type of airplane. Later the company plans to establish a large plant on the Atlantic Seaboard, the location to be determined upon in the near future. The Baltimore plant is to be equipped soon after the first of the year.

First deliveries of Bliss air-cooled radial airplane engines are scheduled for February 1, according to a recent announcement of the E. W. Bliss Co., of Brooklyn. Three sizes are being made under license of the Bristol Aeroplane Co., Ltd., of England: the Bliss-Jupiter, a 9-cylinder model developing 450-550 hp.; a 7-cylinder model, the Bliss-Neptune, developing 300-350 hp.; and Bliss-Titan, of 5 cylinders and 200-250 horsepower.

The Business Barometer

The outlook in Commerce, Finance, Agriculture and Industry

By THEODORE H. PRICE

Editor, Commerce and Finance, New York

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AS A business factor the psychological condition of the American public is probably more important today than ever previously in the history of the country. The boom on the Stock Exchange, and the optimism by which it has been sustained and inflamed have been so well advertised that they are talked about from one end of the country to the other.

The ten or twenty million people who are carrying securities bought on margin regard the advance in prices as logical, and look upon anything that interrupts the upward movement as a malevolent interference with the prosperity of the United States. Most of them think the stock market is a sort of comptometer by which prices are mechanically fixed with reference to assets, earnings, and prospects, and but few of them realize that the fluctuations which are recorded from day to day express the hopes and fears and cupidity of an innumerable army who are profoundly affected by what they read, as well as by what is called "mob psychology."

For these reasons it is exceedingly difficult to say whether the sensational break on the Stock Exchange, which started on December 6, was simply an entre-act in the Coolidge-Hoover boom, or a beginning of the liquidation that has been so long predicted by those who base their views upon precedent.

Last week there was a partial recovery, but the market became relatively quiet at the advance, and some abatement of bullish enthusiasm seems to be noticeable. The weekly statement issued by the Federal Reserve Bank of New York shows a decrease of $219,000,000 in brokers' loans, but the weeks to come must show further decreases before it will be possible to say that there has been a significant reduction in the amount of credit employed in carrying securities. Call money has been a shade easier, but the rates paid for it show that the world's capital is still being requisitioned by New York to finance the operations of those who have bought securities in the hope that they will be salable at a profit later on.

But although it costs about two million dollars a day to operate the machinery of the stock market, its course would not be so important were it not for its reflex action upon the minds and policies of our captains of industry, and the merchants who distribute the goods manufactured. The losses incurred or profits made by speculators are not in themselves significant, but if these losses or profits affect the enterprise or initiative of those who direct the country's business, then they become factors that cannot be ignored.

This aspect of the problem led the writer to ask that the readers of this letter would let him know whether the gyrations of the stock market were having much effect upon business men in their communities. In answer to this inquiry, many letters have been received. Most of them indicate that the merchants and manufacturers of the country are conscious of the stock market, but unaffected by it, and that the trade of the nation would be benefited rather than injured by an early ending of the boom in securities. This is reassuring, and seems to justify confidence in the future of the commercial situation.

Industry continues busy, and most of the country's factories are running at or near to capacity. This is particularly true of the steel and textile mills, the machine shops, and of the automobile manufactories when due allowance for the season is made.

On the thirteen major exchanges where staple commodities are bought and sold for future delivery an increased business has been handled, and prices are, upon the average, higher. Their comparative strength, taken as a whole, is perhaps attributable to the growing belief that consumable merchandise must sell higher if the stock market continues to go up.

The news from abroad, is, upon the whole, encouraging, and the London Stock Exchange has been somewhat cheered by the improvement in King George's condition that is reported as this is written.

The flare-up between Bolivia and Paraguay will probably be settled peacefully, but the incident shows how easily a war might have been started if the fire extinguishers of peace had not been at hand to prevent a conflagration.

The news from China and the Far East is economically encouraging, although there seems to be no doubt about the pitiable distress that prevails in some parts of what used to be called the Chinese Empire. The news from Russia is reassuring, and those who shape the economic policies of the Soviet Government seem to be gradually reverting to the philosophy of capitalism.

In the United States and Canada the outlook is exceptionally propitious, and the only thing to be feared is that we may over-discount the future in our speculative optimism. For this reason it may be well to remember that the world's business organization consists of human units or men, who sometimes become wearied even in well-doing. For the past year or two the business men of America have been working with intense activity and under unusual pressure. A period of rest might be beneficial, even though it involved a lessening of production and distribution, and it may be well to prepare for such a slackening of endeavor.

WHAT'S DOING IN INDUSTRY

FOR the twelfth consecutive month, a progressive increase in the index of machine tool orders is reported by the National Machine Tool Builders Association, when a new high of 280 was reached in November, par being average monthly shipments during the years 1922, 23 and 24. No sign of recession is in sight. In fact, all over the country, even where a temporary pre-inventory lull is being experienced, greater activity than before is expected in the first quarter, at least, of 1929. An interesting sidelight is the fact that the tool builders themselves are purchasing equipment in the face of an unprecedented bank of orders.

TRADE in Chicago has recovered from a temporary recession and is expected to be maintained through the holidays. No decrease in sales is reported in Cleveland, and in Cincinnati a brisk demand is still reported, with many urgent orders calling for overtime in the builders' shops. Buying is holding up well in New England, but inquiry is lighter. In Milwaukee, tool builders have never before approached the end of the year with so much business on the books.

PRODUCTION demands are causing buyers in the Buffalo district to place orders at once. Sales in Philadelphia have kept up well in the last two weeks, after a very active fall, and everything points to brisk business in January. A good volume of orders has been received in the New York market, but some believe there will be a tapering off toward the end of the month. Detroit is about the quietest center, with automotive demand continuing to fall off as inventory time approaches, but an active 1929 is anticipated.

The Industrial Review

Weekly progress of the machinery and machine tool business

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

NEW ENGLAND

Machinery and machine tool buying is holding strongly in the face of approaching holiday and inventory periods. It is now a foregone conclusion that December will be a good month. While the volume is not likely to pass such very good months as September and October the month should be the best December for several years past. According to representative distributors and manufacturers, sales have continued above the seasonal average.

Dealers in rebuilt and used equipment in the New England territory are dividing a steady business in the face of keen competition. Collective opinion from this field anticipates a better than usual replacement business through the inventory period. Small parts plants, it is said, have been pushed to the limit for several months to meet scheduled shipments with an extraordinary machinery wear and tear, all of which will bring replacement orders.

The current week brought out an order for milling equipment placed with a Rhode Island builder. Other orders noted included a profiling machine, threading lathe, drilling unit, shaper and several grinding units. Inquiries have been lighter, but this should not be taken as a true barometer of future business. The picture of New England industry is an optimistic one with metal-working plants on full schedules and a volume of work ahead that should keep factories occupied well into next year.

BUFFALO

The first half of December gave Buffalo machine tool dealers a better business than was anticipated early in the month. Some dealers predicted that the volume would be better for December than for November, although final figures on November generally show a business as good or better than that for October. Sales were widely diversified both as to their nature and as to the industries involved. Some business which was expected would be put off until after New Year's has been closed already because of the fact that the hand of the customer was forced by production demands.

The electrical supply field is keeping pace with the machine tool field in this respect, perhaps slightly behind it, but not noticeably. Conditions in the contractors' equipment field are dull. There has been no snow to create a demand for removal equipment, and building contractors are making present equipment last the season.

MILWAUKEE

While it is apparent that action on some inquiries for metal-working equipment is being deferred until Jan. 1, the general demand for tools continues active, particularly in the field of special production equipment which requires some time to build, and delivery of which extends well into the new year. Into this classification falls considerable of the business from automobile concerns, who are anticipating their needs for the production rush of later winter and early spring, but, because of the season of slackened output, are a smaller factor in current tool buying than in recent weeks.

As a general rule, local manufacturers of equipment have never approached the close of a year with so much business on their books as now, in some instances not even excepting the war period. While domestic business is at a record, export sales are fully as noteworthy, and loom large in the prospects for business in 1929 and succeeding years. Not all tool concerns are experiencing their peak of demand, yet none of them are working at much less than capacity or voicing complaint over current conditions or prospects.

Comment in the tool trade concerning the state of trade emphasizes the point that there seldom has been a time when the demand covered every branch of the metal-working industry. In the past it has frequently been the case that a number of groups have extended a brisk call for machines, while others were doing little or nothing in the direction of buying. It has often been true that while the automobile industry clamored for equipment, many other lines were very slack. The fact that the call for equipment has been and still is so widespread as to embrace all groups is regarded as one of the most encouraging signs of a further continuance of excellent business in the coming year.

DETROIT

That Detroit will remain relatively quiet until at least after the holiday period seems to be assured. Machinery and machine tool dealers are agreed that business is not likely to resume immediately anywhere near the proportions that it has maintained throughout the past 11 months.

Many of the automotive plans are already closing down for inventory or preparing to do so. All of them have eased off on buying and on production for the last several weeks, mostly in preparation for the show in New York.

There is plenty of evidence that next year will be a good one, and almost all of the dealers believe that there will be a large number of orders immediately after the first of the year.

Here and there an occasional order of some importance comes through, but for the most part there is little activity. Most of the dealers welcome the lull inasmuch as it gives them a long sought opportunity to catch up on their orders and to prepare for next year's business.

CINCINNATI

The great majority of the machine tool manufacturers in the Cincinnati district report that business held to its former good level in the past week. There was a small decrease in sales reported by two concerns, this being attributed to seasonal reasons, but taking the industry as a whole this was more than offset by gains made by other concerns. Those who had this small loss in sales regard the matter as but a temporary lull, stating that orders pending should bring business back to its former level.

"Business is holding up in a fine way," said one manufacturer. "Business is showing no tendency to fall off, and the indications are that it will continue at a good level," said a second. "A good volume of orders are coming in, and from the inquiries we are receiving we judge that the demand will continue to be good," stated a third.

A large percentage of the orders booked in the week were of an urgent nature, requesting quick shipmnts, and this has stimulated manufacturing activity, in some cases requiring that forces be increased and in other cases requiring overtime work. The sustaining feature of the week's market, however, was the purchase of single tools by miscellaneous users, as in the past. The business was well scattered over the country and the orders were well diversifid as to size and types of requirements.

A good volume of inquiries flowed in during the week from all sections of the country and were well diversified as to sizes and types of tools. Inquiries received from foreign markets give hope that soon after the first of the year there will be an increased demand from abroad.

PHILADELPHIA

Many machinery and machine tool manufacturers and dealers in this market said that 1928 will pass into history as the best year they have ever experienced from a business standpoint. This situation has been brought about by an exceedingly busy fall, preceded by a summer activity that was better than any summer for several years.

Sales have kept up very well during the last two weeks, it was announced by leaders of the industry, and inquiries now coming in indicate a good start in the New Year. One of the Eastern railroads placed a substantial order with a Philadelphia manufacturer for wheel lathes and other heavy equipment, and other carriers have made inquiries for supplies. General Motors placed a substantial order with one of the Philadelphia manufacturers, and there has been some other buying from the Detroit automobile centers of a substantial nature.

The Landis Tool Co. has purchased some new equipment for its Philadelphia plant. One manufacturer announced it has a substantial order for some machines that are to be delivered in April, indicating that industry generally is anticipating a prosperous year and is preparing for it by ordering equipment months ahead.

There have been some sales of grinding machinery, drills, lathes and other equipment during the last two weeks. Dealers in used machinery report a falling off since the latter part of October.

NEW YORK

Orders placed during the first two weeks of December indicate that the month's business in machine tools will be on a satisfactory level compared with that of recent months, excluding November, which was abnormal due to Wright Aeronautical orders. Only a few believe there will be much of a let-up during the latter part of the month. Dealers and factory representatives report diversified orders coming from well-scattered sources, with little quantity buying. One firm, however, received a $40,000 order calling for four milling machines, a grinder and a radial drill. Purchase of equipment by R. Hoe & Co. is still deferred; four or five turret lathes, some engine lathes and grinders are under consideration. Very active sales in electrically-driven grinders and buffers are reported by one concern.

The General Electric Co. after a period of comparative inactivity has inquired for a number of machines, including five turret lathes, a vertical miller and some engine lathes. The New York Central R.R. has also inquired for needed equipment.

An exporter of tools to Germany reports that the demand has almost been cut in half due to labor troubles in the metal-working shops, but this condition is felt to be only temporary. The demand in the United States for certain types of high-precision measuring equipment, on the other hand, is very active at the present time,

but tariff regulations are seriously hampering the import of other classes of machine tools from Germany.

The Niles Tool Works Co. sold in the past fortnight: a steam hammer, a boring mill and three engine lathes; also a car-wheel borer, a car-wheel lathe and a journal and axle turning lathe to a railroad in the Middle West. In the same period the Pratt & Whitney Co. sold: three profilers, eleven drilling machines, thirteen lathes, three thread millers, six jig borers, four surface grinders, a bench miller and two bench lathes. Detroit automotive plants were well represented in these sales, as well as general manufacturing concerns in Chicago. The local market is normal. Inquiry is holding up well, the company reports.

The Triplex Machine Tool Co. reports the sale of a Triplex combination machine, an Oesterlein Ohio cutter grinder, a Campbell nibbler, a cylindrical grinding machine, two Ames bench lathes, a Swiss jig borer, and a Mikron gear hobber.

CHICAGO

The slight falling off in machine tool business noted last week has not persisted, according to leading machinery concerns. The market seems to have fully recovered from the temporary recession, and the belief, contrary to precedent in the near holiday season, is expressed that an excellent level of business will be maintained until the end of the year.

With these conditions existing and with the sales record of the last six months before them, manufacturers of and dealers in machine tools are most optimistic with respect to at least the first quarter of 1929. Some there are who forecast an increase in business next year over this, but the more conservative element in the trade does not hazard an opinion beyond the first three months.

Buying on the part of general industry continues active. Builders of farm implements and tractors still are heard from with orders and inquiries. In connection with the latter, it may be mentioned that the International Harvester Co. has made the statement that this year has been one of the best in its history in point of output. Used tools are in good demand, and dealers handling this line exclusively are well satisfied with the present outlook.

CLEVELAND

Very little change was noticed during the past week in the local machine tool market. Business is moving along on a steady trend. A few instances are reported of slight increases in sales, and in no case is a decrease recorded. The prevailing feeling is that business will remain steady through December with a general pick-up after the first of the year. Basing their opinions on the number and tone of present inquiries, manufacturers predict that January and February of the new year will exceed November and December in sales.

General Motors made some substantial purchases. Export orders for France, England and Czechoslovakia are reported.

New construction of factories and workshops for the first eleven months of this year compares favorably with the twelve-month period of the last two years, with indications that this year's total will surpass that of the last two years. Construction has been started on a new $2,500,000 copper and brass mill building for the Chase Brass and Copper Co. The Geometric Stamping Co. has started construction of a new $800,000 plant for which considerable new machine tools will be purchased.

A bill extending the duty refund on special machinery not manufactured domestically in Czechoslovakia, until December 31, 1929, has just been passed by the Czechoslovak Parliament, according to a cablegram to the Department of Commerce, Washington.

A.S.M.E. Regional Meeting in Knoxville

Tentative plans are now ready for the Knoxville (Tenn.) regional meeting of the American Society of Mechanical Engineers, to be held March 21, 22 and 23, 1929. The program will include papers on important engineering problems, visits to the rapidly expanding industries of the region as well as trips of scenic beauty. The subjects of the technical program are water-power development, light-metal industries, coal carbonization, executive training, and the resources of the Southern Appalachian area. As a special attraction, a trip will be provided to Kingsport, Tenn., a city that ten years ago was a bare mountain village, but now has the largest plant in the world making complete books, a wood by-product plant, a glass works, textile mills and a cement plant.

S. A. E. Forms Canadian Section

Members of the Society of Automobile Engineers resident in Canada are to be formed into a Canadian section of the association, as a result of a decision reached at a meeting held in Toronto recently, which was attended by about 60 engineers from Toronto and other centers in Ontario. R. H. Combs, president of the Prest-O-Light Co. of Canada, was elected president of the Canadian section, and A. S. McArthur, general superintendent of the Toronto Transportation Commission, vice-president.

Business Items

The Columbia Tool Steel Co., of Chicago Heights, Ill., has moved its Detroit office from 144 E. Woodbridge St. to 1718 Howard St., where larger quarters are provided.

The Cloves Gear Works, of Cleveland, makers of automotive gears, will move to its new plant this month, where it will have four times the present capacity.

A recently filed report of American Car & Foundry Co. and subsidiaries for six months ended October 31, 1928, shows net income of $1,069,816 after charges and federal taxes.

The head office of the Canadian Steel and Wire Co. has been moved from Hamilton to Ojibway, Ontario. The plant and office at Hamilton will be retained as a branch office and warehouse.

The Fish Rotary Oven Co., Walworth, Wis., has transferred its manufacturing plant to Beloit, Wis., where it will erect a $65,000 factory for production of its bakery equipment.

The Decatur Machine Works, 616 E. North St., Decatur, Ill., manufacturers of dies, metal patterns and machine repair tools, last week occupied its new and larger quarters, 30x60 ft. C. R. Yochum is general manager of the plant.

The Smith-Armstrong Forge, Inc., 1209 Marquette Rd., Cleveland, has been incorporated with a capital stock of $150,000 to manufacture flat die hammered forgings. E. A. Smith and E. Armstrong, formerly of the Machinery Forging Co., of Cleveland, are the owners.

The first unit of the new plant of the Chase Brass & Copper Co., of Waterbury, Conn., is being built at Euclid Village, Ohio, a suburb of Cleveland. The Austin Co. is handling the construction work which is to be rushed during the winter so the plant will be ready for operation in the spring.

The Sullivan Machinery Co., Chicago, Ill., announced recently the removal of its offices at Birmingham, Ala., from 2108 First Ave., North, to a temporary location at 613 N. Ninth St. In early 1929, the company expects to move into a new building now under construction.

The consolidated Mining and Smelting Co., of British Columbia, will have in operation early next year, at Trial, B. C., the first steel plant in Western Canada. The first unit will have a production of 10 tons of steel daily. Production will be by the electric method.

The Stockham Pipe & Fittings Co., Birmingham, Ala., has started an enlargement and improvement program that will substantially increase the output, according to Herbert Stockham, president of the company. The company will be operating on the increased basis early next year.

The Botfield Refractories Co., Philadelphia, Pa., manufacturer of Adamant firebrick cement and other refractory materials and the Adamant gun, announces that McCarthy, Jones & Allen Co., Inc., 111 First Ave., South, Nashville, Tenn., has been appointed distributor of all its products.

Directors of the Caterpillar Tractor Co., San Leandro, Calif., at a meeting in San Francisco voted to offer stockholders the right to subscribe to new shares of stock for the purpose of raising $8,500,000 in order to expand facilities. The company recently acquired the Russell Grader Manufacturing Co., Minneapolis.

Directors of the Borg-Warner Corporation, Chicago, and the Galesburg-Coulter Disk Co., Galesburg, Ill., have agreed upon the consolidation of the two automobile parts firms, and stockholders of both corporations have been asked to approve the plan, which necessitates an exchange of stock.

The entire plant and offices of the R. & R. Manufacturing Co., of Ind., maker of overhead valve equipment for Chevrolet cars, are to be moved to new quarters at Madison and Nichol Aves., according to Robert M. Roof, manager. Business during the winter is expected to be record breaking, particularly due to foreign orders.

The Canadian de Haviland Corporation has purchased 20 acres of land on the outskirts of Toronto, Ont. Plans of the new concern, which represents the entry of the British aircraft manufacturers into the Dominion, are to erect a small factory and hangars, with provision for future expansion.

Stockholders of Chicago Pneumatic Tool Co., New York, will meet Dec. 31 to vote on a plan of recapitalization, which provides that the present capital of 94,000 shares be changed into new preferred and new common stocks. It is proposed to issue 188,000 shares of $50 par $3.50 convertible preference stock.

A large addition recently completed to the plant of the Anderson Stove Foundry Co., Anderson, Ind., has been put in use. The new building relieves congestion in other departments. Workmen are rushing work on the construction of another building which will be used for stockroom purposes. It is 60 x 100 feet.

The Dominion Road Machinery Co., Ltd., of Goderich, Ont., is making additions to its plant by the construction of a new building of reinforced concrete, thereby increasing manufacturing facilities by about 75 per cent. The increased demand for road machinery and equipment, together with the service required, has made this extension of plant necessary.

Directors of Stanley Works, New Britain, Conn., have voted to declare an extra dividend of 3 per cent on common stock payable December 17 to stockholders of record December 7. This is in addition to the regular 2½ per cent dividend on the common payable in January. Directors also declared a 1¾ per cent dividend on the preferred stock to be paid February 14.

The Timken Roller Bearing Co., of Canton, Ohio, has established two new permanent offices on the Pacific Coast, one at Los Angeles, Calif., with Roy Cross in charge, at 1361 South Figueroa St.; the other at 321 South Pine St., Seattle, Wash., with Marshall Cooledge in charge. G. C. McMullen remains in charge of the San Francisco office.

The Hill Clutch Machine & Foundry Co., Cleveland, power transmission manufacturer, has appointed C. R. McGahey as sales engineer in charge of the Southeastern district, including the states of Virginia, Tennessee, Georgia, Florida, Alabama, Mississippi, Louisiana and the Carolinas.

Articles of incorporation have been filed by the Mayer Brothers Co., of Brazil, Ind. The corporation has an initial capital stock of $25,000 common and $25,000 preferred and is formed to "Manufacture power hammers, boilers, engines and all kinds of machinery." The incorporators are Lorenz L. Mayer, Louis Mayer and Bertram L. Mayer.

The B. G. Coghlin Co., Ltd., Montreal, manufacturer of springs, track tools and railway supplies, is increasing the size of its factory to provide for additional heat-treating equipment for railway springs. The new equipment will include a number of furnaces and tempering tanks, and some additional machinery, which will be housed in a new building.

To cope with increased business, General Motors of Canada, Ltd., are doubling the capacity of their stamping plant at Oshawa, Ontario, and will employ 300 more men in this unit. The basement under the present stamping plant is being made ready for occupancy at a cost of about $40,000, and an additional $40,000 will be spent on new machinery.

The directors of the Ludlum Steel Co., Watervliet, N. Y., have voted to take over the Atlas Steel Co. of Dunkirk, N. Y., the property of which is said to be valued at about $8,000,000. The Ludlum company is located at Watervliet, N. Y. The stockholders of the Atlas Steel Co. will be offered 100,000 shares of stock of no-par value by the directors of the Ludlum company.

Montreal and Toronto interests, headed by J. L. McSweeney, president of the Equitable Securities Corporation, have purchased the McKinnon Steel Co., of Sherbrooke, Que. This company, which has been owned and operated as a family concern for the past twenty years, specializes in the manufacturing of steel frames for buildings, steel bridges and steel tanks. The new owners intend making extensive additions to plant and equipment immediately.

The Oberhelman-Ritter Foundry Co. has been formed as a closed corporation to succeed the J. A. Oberhelman Foundry Co., 3,323 Colerain Ave., Cincinnati. Capitalization is listed at $200,000. R. K. LeBlond, E. A. Mueller, H. P. Ritter, A. J. Oberhelman, and B. W. Broeman are incorporators. Mr. Oberhelman will be president and Mr. Ritter vice-president and secretary. The other incorporators will serve on the board.

The directors of the Jaeger Machine Co. and the Lakewood Engineering Co. have agreed to merge the two concerns subject to the approval of the stockholders of each. Both concerns manufacture concrete mixing, handling and placing machinery. Plans provide that all assets of the Lakewood company will be transferred to the Jaeger company. The sales and distribution department of each company will be continued as before.

A sales conference of the Abrasive Co., Philadelphia, Pa., was held on December 3 to 5, in Philadelphia, under the direction of S. M. Hershey, sales manager. Headquarters for the conference were established at the Penn Athitic Club, and the meetings were distributed between the factory at Bridesburg and the club. Activities included the inspection of a new plant of the company, in which demonstrations of typical grinding operations were shown.

The Bethlehem Steel Corporation of Bethlehem, Pa., and the American Universal Mill Co. of Scranton, Pa., filed suit against the United States Steel Corporation and its subsidiaries, the Carnegie Steel Co. and the American Bridge Co., alleging the infringement of five patents with a value in excess of $250,000,000. All five patents cover the manufacture of steel beams and girders used in practically every type of building construction, according to W. W. Robertson, a counsel for the Bethlehem company.

Consummation of the plan of a merger of the Hupp Motor Car Corporation and the Chandler-Cleveland Motors Corporation will follow deposits of at least 95 per cent of the present stock and 95 per cent of the common stock of the Chandler-Cleveland concern. This makes the third important consolidation this year in the automotive industry. Earlier in the year, the Chrysler Corporation acquired control of Dodge Brothers Corporation, while the Studebaker Corporation gained control of the Pierce-Arrow Motor Car Company.

The Wrought Iron Co. of America has been formed under the laws of Pennsylvania to consolidate manufacturers of wrought-iron products and build up a large organization specializing in this field. The company embraces the present consolidation of the Lebanon Iron Co. and the Scranton Bolt and Nut Co., which will form the nucleus for the proposed larger combination. Charles Hart has been named president of the new company. He was formerly vice-president of the Republic Iron and Steel Co., and president of the Inland Steel Company.

The Morrison Machine Co., 204 Van Houten St., Paterson, N. J., manufacturer of textile finishing machinery and a line of speed reducers, has purchased the machine shop and administration building of the Cooke Works of the American Locomotive Co., Madison and Getty Aves., Paterson, and will transfer its operations there. Three times the present floor space will be provided, and facilities will be enlarged accordingly. The foundry of the same works was purchased by the Wright Aeronautical Corporation during the past summer, and an additional foundry is being erected there by the Wright concern.

The Lombard Tractor & Truck Corporation, Waterville, Me., has been merged with the Linn Manufacturing Co., Morris, N. Y. Officers have been elected as follows: President, G. R. Hanks, who is also vice-president of the Taylor Wharton Iron & Steel Co., N. J.; vice-president, George Whitman; treasurer, H. J. Charles, Waterville; secretary, Lincoln Johnson, New York. The board of directors consists of: J. A. Bowers, vice-president New York Trust Co.; W. F. McQuire, formerly of the Wayne Pump Co., New York; C. H. Jones, George Whitman, John Ware, G. R. Hanks, D. E. Stalter, and S. T. Callaway.

The Kari-Keen Manufacturing company, Sioux City, Iowa, makers of luggage carrier devices for automobiles, organized in 1925 with $25,000 capital, which a year later was doubled, has been reorganized and will be incorporated, under Delaware charter, with 300,000 no-par shares. Expansion of the plant, which last summer had a capacity production of 500 carriers a day and is now on a 300-a-day basis, to 2,000 carriers daily in the spring is announced. Dr. B. H. Sprague, Huron, S. D., president of the company, becomes chairman of the board and Cecil H. Myers, vice-president and general manager, becomes president. W. W. Wilson is production manager.

Personals

LEONARD A. BLACKBURN, formerly resident engineer of the Oakland Motor Car Co., has become special engineer in the production department.

CHARLES G. PFEIFFER, president of the Specialty Engineering Co., Philadelphia, Pa., was injured in New York on Dec. 7 while attending the annual meeting of the American Society of Mechanical Engineers.

JOHN J. OTT, president and general manager of the B. Ott & Sons Co., LaCrosse, Wis., retired December 1. The business is being continued by Gustav Ott, vice-president, and F. A. Ott, secretary and treasurer.

JOHN L. F. ROSS, formerly with the Bailey Meter Co. of Cleveland, has been appointed toolroom foreman of the Cuyahoga Spring Co., Cleveland, manufacturer of wire coil springs and special wire hardware.

JAMES A. ANDERSON, formerly superintendent of the Milwaukee shops of the Chicago, Milwaukee, St. Paul & Pacific, has been appointed assistant superintendent of motive power in charge of shops and machinery for the Milwaukee system.

D. H. MCDOUGALL, consulting engineer, Toronto, Ont., and formerly vice-president of the Dominion Steel Corporation, has been named official investigator of the Tariff Advisory Board, appointed by the Dominion Government to study various phases of the steel industry in Canada.

MONARD V. HAYES, consulting management engineer announces the opening of an office at 11 West 42nd St., New York City, to specialize in accounting to aid management. Special consideration will be given to budget control, production costs, management statements, organization counsel, commercial research, location and layout and evaluations and interpretations.

JOHN E. KELLEY retires as general sales manager of the Simonds Saw and Steel Co., Fitchburg, Mass., on Dec. 31, after having been associated with the company for the last 33 years. He started in as a salesman, was advanced to branch manager, and then to general sales manager and secretary. Mr. Kelley plans to spend the next few months at his Florida home, 740 Beach Drive, St. Petersburg.

H. A. HOUSTON, of Wilkinsburg, Pa., has been appointed works manager of the R. D. Nuttall Co., Philadelphia, Pa., maker of Westinghouse-Nuttall gears, and a subsidiary of the Westinghouse Electric & Manufacturing Co. Mr. Houston has served as apprentice, machinist and locomotive tester for the St. Louis & San Francisco R.R.; mechanical engineer and trainmaster for the Chicago, Rock Island and Pacific R.R., and since 1920, manager of mechanical parts, railway-equipment engineering department of the Westinghouse concern.

Obituaries

GEORGE R. BRANDON, mechanical engineer and formerly chief engineer of the Whiting Foundry & Machine Co., died on Dec. 6 at the Chicago Engineers Club.

HENRY O. TAYLOR, 54, founder and president of the Taylor-Tenoning Machine Co., Rockford, Ill., died recently in that city. He had been a resident of Rockford for 35 years and 18 years ago founded his company. He held several patents on special machinery.

GEORGE FRANCIS HUTCHINS, eighty-seven, engineer and inventor, and until his retirement in 1927, superintendent of the Crompton & Knowles Loom Works, Worcester, Mass., died on December 12. Since 1873 he had been with the Knowles firm, and had assisted in the development of the company's looms, and had taken out ninety-six patents relating to the loom industry.

Forthcoming Meetings

Western Metal Congress and Western States Metal & Machinery Exposition. Held in Los Angeles, Jan. 14-18, under the auspices of the American Society for Steel Treating. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland.

Society of Automotive Engineers. Annual meeting, Jan. 15-18, Book-Cadillac Hotel, Detroit. C. E. Haywood, in charge of meetings, 29 W. 39th St., New York City.

American Management Association. Production Executives' conference, Feb. 27-28 and Mar. 1, at the William Penn Hotel, Pittsburgh, Pa. Oscar Grothe, vice-president in charge of the production executives' division, c/o White Sewing Machine Co., Cleveland, Ohio.

American Society of Mechanical Engineers. Regional meeting in Knoxville, Tenn., March 21-22, 1929. W. R. Woolrich, professor of mechanical engineering, University of Tennessee, Knoxville, in charge of program.

American Management Association. Marketing Executives' Conference, April 3-4, at the Hotel Gibson, Cincinnati, Ohio. George R. Cain, vice-president in charge of the marketing Executives' division, American Management Association, 20 Vesey St., New York City.

American Society of Mechanical Engineers. Semi-annual meeting, July 1-4, 1929, in Salt Lake City, Utah. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

The Weekly Price Guide

Rise and Fall of the Market

IRON, the basic material, continues in a strong market, with prices tending upward. No. 2 fdry. pig iron, for example, rose 50c. per ton this week, to $17, maximum, at Birmingham. Steel follows iron in price firmness, with demand active in plates, bars, rails, and tin plate. There is seasonal tapering off, however, in buying of pipe, automotive material and fabricated structurals. Non-ferrous metals are also moving upward, with prices higher than a week ago on warehouse deliveries of tin, lead, zinc, solder and babbitt metal. Antimony proved to be the exception this week, by declining. Among the oils, cutting grades are higher at Western points, while prices of linseed and machine oil tend in the opposite direction.

(All prices as of Dec. 14, 1928)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b:

CINCINNATI	
No. 2 Southern (silicon 1.75@2.25)	$19.94
Northern Basic	20.89
Southern Ohio No. 2	21.19
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 1.75@2.25)	25.50
BIRMINGHAM	
No. 2 Foundry (silicon 1.75@2.25)	16.50@17.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	21.76
Virginia No. 2	27.17
Basic	20.76
CHICAGO	
No. 2 Foundry local (silicon 1.75@2.25)	20.00
No. 2 Foundry, Southern (silicon 1.75@2.25)	22.26
PITTSBURGH, including freight charge ($1.75) from Valley:	
No. 2 Foundry	19.26
Basic	19.26
Bessemer	21.26

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb:

Detroit	4.50
Cleveland	5.00
Cincinnati	4.30
New York	5.25
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.00@2.10	3.35	3.25	3.90*
No. 12	2.06@2.15	3.40	3.30	3.95*
No. 14	2.15@2.25	3.45	3.35	4.00*
No. 16	2.25@2.35	3.55	3.45	4.10*
Black				
Nos. 18 to 20	2.55@2.65	3.60	3.40	4.00
No. 22	2.70@2.80	3.75	3.55	4.15
No. 24	2.75@2.85	3.80	3.60	4.20
No. 26	2.85@2.95	3.90	3.70	4.30
No. 28	3.00@3.10	4.50	3.85	4.45
Galvanized				
No. 10	2.70@2.80	3.95	3.75	4.25
Nos. 12 to 14	2.80@2.90	4.05	3.85	4.35
No. 16	2.90@3.00	4.15	3.95	4.45
No. 18	3.05@3.15	4.30	4.10	4.60
No. 20	3.20@3.30	4.45	4.30	4.75
No. 22	3.25@3.35	4.50	4.35	4.80
No. 24	3.50@3.60	4.65	4.45	4.95
No. 16	3.65@3.75	4.90	4.70	5.20
No. 28	3.90@4.00	5.15	4.95	5.45

*250 to 3,999 lb.

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Galv.
1 to 3 in., butt welded	50%	36%	55½%	43½%	54%	41%
2½ to 6 in., lap welded	45%	32%	53½%	40½%	51%	38%

WROUGHT-STEEL PIPE LIST

Size, Inches	List Price per Foot	Diameter in Inches—External	Diameter in Inches—Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb:

— Thickness —		Outside Diameter in Inches						
Decimal Fractions	B.w.g. and	½	⅝	¾	⅞	1	1¼	1½
		Price per Foot						
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse base prices in cents per lb:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	6.05	6.00	6.20
Hoop steel	4.50†	4.00	4.15
Cold rolled strip steel	6.25	6.00	6.10
Floor plates	5.10†	5.30	5.00
Cold drawn, round or hexagon‡	3.40	3.65	3.60
Cold drawn, flat or square‡	3.90	4.15	4.10
Structural shapes	3.30†	3.00	3.10
Soft steel bars	3.25†	3.00	3.00
Soft steel bar shapes	3.25†	3.00	3.00
Soft steel bands	4.00†	3.65	3.65
Tank plates	3.30†	3.00	3.10
Bar iron (2.75 at mill)	3.24	3.00	3.00
Drill rod (from list)	60%	55%	50%

*Flat, $\frac{3}{16}$@$\frac{1}{2}$-in. thick. †250 to 3,999 lb., ordered and released for shipment at one time. ‡Cold finished steel, shafting and screw stock.

Electric welding wire, New York, $\frac{3}{32}$, 8.35c.; $\frac{1}{8}$, 7.85c.; $\frac{3}{32}$ to $\frac{1}{8}$, 7.35c. per lb.

METALS

Warehouse Prices in Cents Per Pound for Small Lots:			
Copper, electrolytic, New York			16.75
Tin, Straits, pigs, New York			54.75
Lead, pigs, E. St. Louis	6.35	New York	8.00
Zinc, slabs, E. St. Louis	6.35	New York	8.00

	New York	Cleveland	Chicago
Antimony, slabs	13.25	14.00	14.25
Copper sheets, base	25.00	25.00	25.00
Copper wire, base	21.21¾	21.25	17.87½*
Copper bars, base	23.50	23.50	24.00
Copper tubing, base	26.37½	26.37½	26.37½
Brass sheets, high, base	20.50	20.50	20.50
Brass tubing, high, base	25.37½	25.37½	25.37½
Brass rods, high, base	18.25	18.25	18.25
Brass wire, high, base	21.00	21.00	21.00

*At mill.

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%.....	25.00*	24.30	24.30
Zinc sheets (casks).....	10.00@10.50	11.00	10.11
Solder (½ and ¼).....	36.00	35.00	31@34
Babbitt metal, delivered in case lots, New York, cents per lb:			
Genuine, highest grade.....			69.50
Commercial genuine, intermediate grade.....			53.00
Anti-friction metal, general service.....			31.50
No. 4 babbitt (f.o.b.).....			12.25

*Delivered.

NICKEL AND MONEL METAL—Price in cents per lb., base, f.o.b. Huntington, W. Va:

	Nickel	Monel Metal
Sheets, full finished.....	52.00	42.00
Sheets, cold rolled.....	60.00	50.00
Strip, cold rolled.....	55.00	45.00
Rods, hot rolled.....	45.00	35.00
Rods, cold rolled.....	53.00	40.00†
Tubing.....	75.00*	90.00
Angles, hot rolled.....	50.00	40.00
Plates.....	52.00	42.00

*Seamless. †Cold drawn.

OLD METALS—Dealers' purchasing prices in cents per pound, f.o.b. cars, depending on quantity:

	New York	Cleveland	Chicago
Crucible copper.....	14.25 @14.37½	13.75	12.75 @13.25
Copper, heavy, and wire..	13.00 @14.12½	13.00	12.12½@12.50
Copper, light, and bottoms	11.75 @12.25	11.00	11.00 @11.50
Heavy lead.....	5.12½@ 5.50	6.25	4.75 @ 5.25
Tea lead.....	3.50 @ 4.00	4.25	3.75 @ 4.25
Brass, heavy, yellow.....	7.75 @ 8.00	8.50	8.00 @ 8.50
Brass, heavy, red.....	10.75 @11.25	....	10.25 @10.75
Brass, light.....	6.25 @ 6.75	6.75	6.75 @ 7.25
No. 1 yellow rod turnings.	9.00 @ 9.50	9.50	8.75 @ 9.25
Zinc.....	3.00 @ 3.50	3.25	3.00 @ 3.50

TIN PLATES—Charcoal—Bright—Per box:

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20.....	$12.10	$11.95	$11.50
"A" Grade:				
IC,	14x20.....	9.70	9.90	9.50
Coke Plates—Primes—Per box:				
100-lb.,	14x20.....	6.45	6.10	7.00
Terne Plates—8-lb. Coating—Small lots—Per box:				
IC,	14x20.....	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.*	$0.10@0.13½	$0.16	$0.15
Cotton waste, colored, per lb.*	.09@ .13	.12	.12
Wiping cloths, washed white, per lb.†.....	.16@ .16½	38.00 per M	.16
Sal soda, per lb.....	.02	.02	.02
Roll sulphur, per lb.....	.027	.03½	.04
Linseed oil, raw, in 1 to 4 bbl. lots, per lb.....	.108	.11	.112
Cutting oil, about 25% lard, in gal. cans, per gal.....	.65	.60	.65
Machine oil, medium-bodied (55 gal. steel bbl.) per gal..	.30	.36	.35
Belting — Present discounts from list in fair quantities (½ doz. rolls) for leather or rubber:			
Leather—List price, 24c. per lin. ft., per inch of width, for single ply:			
Medium grade.....	30–10%	30–10%	35%
Med. grade, heavy wgt...	30– 5%	30– 5%	30%
Rubber transmission, 6-in. 6 ply, $1.83 per lin.ft:			
First grade.....	50%	50–10%	50%
Second grade.....	60%	60– 5%	50–10%

*All waste in bale lots. †100-lb. bales or less.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars.....	per lb..	$0.0325	$0.0325	$0.0324
Cold drawn shafting...	per lb..	.034	.034	.04
Brass rods.....	per lb..	.1825	.1825	.165
Solder (½ and ¼).....	per lb..	.36	.35	.3675
Cotton waste, white...	per lb..	.10@.13½	.10@.13½	.10@.13½
Disks, aluminum oxide mineral, cloth, No. 1, 6-in. dia.....	per 100.	3.59	3.59	3.10
Lard cutting oil.....	per gal.	.65	.65	.65
Machine oil.....	per gal.	.30	.30	.27
Belting, leasteh, medium.....	off list..	30–20%	30–10%	35%
Machine bolts, up to 1x30 in., full kegs...	off list..	50%*	50%*	50%*

*List prices as of April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials — Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
Flint paper.....	$4.05	$4.29	$4.29
Emery cloth.....	20.22	20.97	20.97
Disks, aluminum oxide mineral, 6 in. dia., No. 1, per 100:			
Paper.....	2.04	2.04	2.04
Cloth.....	3.59	3.59	3.59
Fire clay, per 100 lb. bag.....	1.00	.75	.75
Coke, prompt furnace, per net ton...	Connellsville,		2.85@3.00
Coke, prompt foundry, per net ton...	Connellsville,		4.00@4.50
White lead, dry or in oil...	100 lb. kegs....	New York,	13.25
Red lead, dry.....	100 lb. kegs....	New York,	13.25
Red lead, in oil.....	100 lb. kegs....	New York,	14.75

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

	Full Kegs or Cases
Machine bolts, square heads and nuts:	
Up to ¾ x 6-in.....	55%
Larger up to 1 x 30-in.....	50%
1¼ and 1½ in. dia.....	35%
Carriage bolts:	
Up to ½ x 6-in.....	55%
Larger sizes.....	50%
Coach and lag screws:	
Up to ½ x 6-in.....	55%
Larger sizes.....	50%
Tap bolts, hexagonal heads.....	40%
Nuts:	
Hot pressed, square and hexagonal, blank or tapped, up to 1-in., incl.....	55%
Cold punched, square and hexagonal, blank or tapped, up to 1-in. incl.....	55%
Semi-finished, hexagonal, tapped, in packages, all sizes.....	40%
Case hardened, hexagonal, tapped, in packages, all sizes.....	30%
Washers: Deduct from list, per 100 lb.....	$3.50*
Rivets, button and cone head:	
Small, including 7/16-in. dia.....	50–10%
Large (base) per 100 lb. net.....	$5.00†

Note—For less than full package quantities on bolts, screws, hot-pressed and cold-punched nuts, add extra of 10 per cent to list.
*Broken keg lots, $1.50 off list. †Broken keg lots, $6.50 net.

Machine Requirements and Industrial Construction

Equipment Wanted

Ind., Anderson — Marine Wire Co., 31st and Big Four R.R.—machinery and equipment for plant.

Mass., Cambridge (Boston P. O.)—New Method Dye Co., 30 Cross St.—circular saw table with motor, drill press, large and small a.c. scroll or jig saw.

Mich., Detroit — Detroit Body Die Co., 3450 Wight St.—one side planer.

Mich., Detroit—Kettlewell Co., 3429 East Jefferson Ave., (metal parts)—shaper and equipment.

Mich., Detroit—Morse Counterbore & Tool Co., 2007 Poplar Ave.—machine shop equipment including lathe.

Mich., Detroit — Motor Products Corp., 11801 Mack Ave.—machine shop equipment for the manufacture of automobile parts for proposed 1 and 2 story, 80 x 100 and 60 x 100 ft. factory. Estimated cost $250,000.

Ont., Hespeler—Z. A. Hall—woodworking equipment for the manufacture of express wagons, sleighs, etc., for recently acquired plant.

Ont., Kitchener—F. J. Steffler, 30 Grenville Ave.—metal and woodworking machinery, motors and parts for the manufacture of snowmobiles for Dominion Motor Sleigh Co., recently organized. Estimated cost $50,000.

Ont., London—General Steel Wares Ltd., York St.—machinery and equipment for the manufacture of enameled ware for household goods for proposed 1 story, 150 x 250 ft. addition to factory on Adelaide St. Estimated cost $100,000.

Ont., Toronto—Toronto Iron Works, ft. of Cherry St.—electric power and traveling cranes for proposed 1 story steel fabricating shop. Estimated cost $500,000.

Ont., St. Catharines — W. S. Tyler Co., 3615 Superior Ave. N.E., Cleveland, O.—equipment for the manufacture of woven wire screens, ornamental iron, bronze work, etc., for proposed factory here on Ontario St. Estimated cost $100,000.

Opportunities for Future Business

Calif., Eureka — Northwestern Pacific R.R., 64 Pine St., San Francisco, plans the construction of a round house, repair shop, etc., at ft. 4th St., here. Estimated cost $14,845.

Calif., Long Beach—City, H. S. Callahan, Mgr., plans the construction of a municipal garage. Estimated cost $200,000.

Calif., Los Angeles—Bergstrom Steel Co., 613 North Hewitt St., awarded contract for a 1 story, 50 x 250 ft. factory on Slauson Ave.

Calif., Los Angeles—Los Angeles Can Co., 303 San Fernando Rd., awarded contract for a 1 and 2 story, 300 x 500 ft. factory.

Calif., Los Angeles—Willard Storage Battery Co., East 131st St. and St. Clair Ave., Cleveland, O., plans the construction of a factory here. Estimated cost $250,000.

Calif., Oakland — Kings County Packing Co., Reedley, awarded contract for the construction of a plant including machine shop, etc. Estimated cost $500,000.

Calif., Tiburon — Northwestern Pacific R.R. Co., 64 Pine St., San Francisco, awarded contract for the construction of a 1 story machine shop, here. Estimated cost $32,520.

Conn., Bristol—Wallace Barnes Co., 30 Main St., manufacturers of springs, plans addition to plant at South Elm and Wallace Sts. Estimated cost to exceed $150,000. Private plans.

Ill., Belleville—Baker Stove Co., 818 Church St., is having preliminary plans prepared for a 3 story, 115 x 120 ft. stove factory at Cleveland and Freeburg Aves. Estimated cost $40,000. Gill & Jackson, 520 Budel Bldg., St. Louis, Mo. Archts.

Ill., Springfield—Monarch Tractor Corp., subsidiary of Allis-Chalmers Mfg. Co., West Allis, Wis., will soon receive bids for the construction of a plant. Estimated cost $750,000.

Ind., Fort Wayne—Old Fort Tire Co., awarded contract for the construction of a machine shop and service station at Wayne and Clay Sts. Estimated cost $46,000.

Ind., Indianapolis—Peerless Foundry Co., W. G. Williams, Pres., Ludlow Ave., awarded contract for a 77 x 141 ft. foundry at 1843 Ludlow Ave. Estimated cost $46,000.

Ind., Logansport — International Harvester Co., 606 South Michigan Ave., Chicago, Ill., awarded contract for two 70 x 110 ft. plants here. Estimated cost $40,000.

Ind., Newcastle—Chrysler Corp., S. E. Welch, Supt., will build an 80 x 80 ft. automobile plant at 18th St. and I Ave. Estimated cost $40,000. Private plans.

Ind., Shelbyville—Chambers Mfg. Co., manufacturers of gas ranges, awarded contract for a 2 story, 50 x 120 ft. factory. Estimated cost $43,000.

Md., Baltimore — Bartlett-Hayward Co., Scott and McHenry Sts., build a 1 story, 53 x 313 ft. addition to plate shop. Estimated cost $20,000.

Mich., Detroit—Knox-Kay Co., Linwood and Clement Sts., awarded contract for a 1 story, 90 x 120 ft. sales and service station at Linwood and Clements Sts. Estimated cost $40,000.

Mich., Flint—Fisher Body Corp., General Motors Bldg., Detroit, is having plans prepared for the construction of a 1 story, 120 x 280 ft. and 50 x 180 ft. addition to body plant, here. Estimated cost $75,000.

Minn., Minneapolis—Grau-Curtis Co., 613 First Ave. N. E., furniture manufacturers, awarded contract for a 2 story, 137 x 144 ft. factory on First Ave. and 6th St. N.E. Estimated cost $100,000. Noted Dec. 13.

Minn., St. Paul—L. C. Simons, 1381 Raymond St., awarded contract for a 1 story garage at University and Raymond Aves. Estimated cost $100,000. General Motors Truck Co., 240 West 5th St., lessee.

N. H., Manchester—Perreault & Labonte, Elm St., will soon award contract for a 2 story repair and service garage at Blodgett, Black & Elm Sts. Estimated cost $40,000. C. R. Whitcher, 814 Elm St., Archt.

N. J., Irvington—Freas Thermo Electric Co., awarded contract for a 1 story, 90 x 160 ft. factory. Estimated cost $50,000.

N. J., Kearny — Western Electric Co., Inc., 195 Broadway, New York, awarded contract for the construction of a group of factory buildings, here. Estimated cost $1,250,000. Private plans.

N. J., Townley — Metals Disintegrating Co., awarded contract for a 2 story, 55 x 110 ft. factory. Estimated cost $40,000.

N. Y., Brooklyn—A. D. Denis, 551 Sea Beach Rd., plans the construction of a 2 story shop and garage. Estimated cost $40,000. A. Goldberg, 164 Montague St., Archt.

N. Y., Brooklyn—B. Lewittes, 8908 Northern Blvd., Long Island City, is receiving bids for a 2 story, 82 x 237 ft. garage at West 35th St. and Surf Ave. here. Estimated cost $100,000. M. Schantz, 25 Spruce St., Archt. Noted Dec. 13.

N. Y., Brooklyn — S. Manlay, c/o M. Klein, 65 Court St., Archt., will build a 1 story, 100 x 160 ft. garage at Middleton St. and Marcy Ave. Estimated cost $50,000. Noted Dec. 13.

N. Y., Brooklyn—Para Realty Corp., L. Raichelson, Pres., 191 East 39th St., plans the construction of a 1 story, 100 x 100 ft. garage at Glenmore Ave. and Barbey St. Estimated cost $40,000. H. J. Nurick, 44 Court St., Archt.

N. Y., Brooklyn—Polblum Corp., I. Polwnich, Pres., 26 Court St., plans the construction of a 1 story, 90 x 107 ft. garage at Dean St. and Troy Ave. E. M. Adelsohn, 26 Court St., Archt.

N. Y., Brooklyn—P. Schwartz, Manhattan Ave. and Richardson St., is receiving bids for the construction of a garage, etc. Estimated cost $40,000. C. M. Spindler, 164 Montague St., Archt.

N. Y., Jackson Heights—Myward Construction Co., 6730 Herman St., plans the construction of a 100 x 130 ft. garage at 70th St. and Hays Ave. Estimated cost $40,000. M. Perlstein, c/o owner, Archt.

N. Y., Long Island City—E. J. Foy, Skillman Ave., plans the construction of a 2 story, 98 x 100 ft. garage at Skillman Ave. and East Lowery St. Estimated cost $40,000. Private plans.

N. Y., New York—S. Glass, 2506 Grand Concourse, and M. Horowitz, 703 West 171st St. will build a garage at Jerome and Mt. Eden Aves. W. J. Ort, 424 East 149th St. Archt.

N. Y., New York—Laura Realty Corp. Inc., D. Snow, Pres., 200 West 72nd St., will build a 5 story garage at 524 East 73rd St. Estimated cost $150,000. W. C. Sommerfeld, 31 Union Sq., Archt. Noted Dec. 13.

O., Cleveland — Bd. of Education, F. G. Hogen, Dir., is having revised plans prepared for the construction of a 1 story foundry on Eagle Ave. Estimated cost $40,000. G. M. Hopkinson, Auditorium Garage Bldg., Archt. Noted Nov. 29.

O., Cleveland—Lake Erie Metal Products Co., J. F. Strand, Gen. Mgr., Dunham Rd., had plans prepared for a 1 and 2 story, 75 x 100 ft. factory. Estimated cost $50,000. H. W. Grieme, Engineers Bldg., Archt.

O., Cleveland—Murray Ohio Mfg. Co., C. W. Hannon, Pres., 1115 East 152nd St., manufacturers of sheet metal stampings, had plans prepared for a 2 story, 64 x 239 ft. addition to plant on East 152nd St. Estimated cost $150,000. George S. Rider Co., Century Bldg., Archt.

Pa., Chester—T. Rosenbloom, c/o Coshland & Beard, Crozer Bldg., Archts. plans the construction of a 2 story, 88 x 260 ft. garage at 5th and Chester Sts. Estimated cost $200,000.

Pa., Philadelphia — T. S. Gassner Co., 4545 Wayne Ave., awarded contract for a 2 story, 69 x 110 ft. factory for the manufacture of metal windows at Wayne and Apsley Sts. Estimated cost $65,000.

R. I., Providence—Dept. of Public Works, City Hall, awarded contract for the construction of a repair shop, etc. at Bexter and Whitmarsh Sts. Estimated cost $65,000. T. J. H. Pierce, Engr. Noted Nov. 22.

Ont., Toronto—Canada Metal Co., Ltd., 29 Fraser Ave., plans the construction of a factory for the manufacture of metal products. Estimated cost $50,000. Architect not selected.

Ont., Toronto—La France Fire Engine & Foamite, Ltd., 195 Weston Rd., awarded contract for addition to factory. Estimated cost $50,000.

Ont., Toronto—National Motors, Ltd., 49 Bloor St. W., plans the construction of a 2 or 3 story garage. Estimated cost $100,000 to $200,000. Architect not selected.

Sask., Regina—Exide Battery Co., plans the construction of a plant. Estimated cost $50,000.

Que., St. Laurent—R. Mitchell Co. Ltd., Brewster Ave., Montreal, plans the construction of a foundry, here. Estimated cost $100,000.